

GOVERNMENT OF INDIA
PLANNING COMMISSION

REPORT
OF THE
ENGINEERING PERSONNEL
COMMITTEE



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CHAPTER I INTRODUCTION

1. An important result of the first five year plan has been the awareness created in the public mind of the problem of technical manpower in the context of planning. The large demand on the nation's resources of scientific and technical personnel during the first plan period could not be met by the available training facilities. As the Planning Commission has put it, "Experience in the first five year plan bears out the fact that even in the more developed States, a moderate expansion in the development programme to be undertaken soon strains the available resources of technical personnel, especially at the higher levels". In particular, acute shortages of engineering skills came to the surface in the last five years so often that it was considered essential for the success of the second five year plan, with its emphasis on heavy industry and transport, to analyse the supply and demand for engineering personnel. This analysis assumes a special significance in India, where employment is one of the major objectives of planning and construction activity which demands such personnel is expected to play an important role in providing employment opportunities.

2. A number of attempts at assessing the requirements of engineering personnel in isolated sectors have recently been made in the Ministries at the Centre and in the States. For instance, the Ministries of Irrigation & Power, Communications, Production, Railways and Iron & Steel have independently assessed their requirements for implementing the development programmes under the second plan. A few State Governments which anticipated acute shortages have also assessed their demand for engineering skills. To undertake an overall assessment of demand and supply in this respect, therefore, the Planning Commission set up the Engineering Personnel Committee under its Resolution No. PC(VI)L(E)III-15/55 dated September 26, 1955 (Appendix A). The Committee consisted of :

Chairman :

SHRI Y. N. SUKTHANKAR
Secretary, Planning Commission.

Members :

SHRI VISHNU SAHAY,
Secretary, Ministry of Labour.
SHRI KANWAR SAIN,
Chairman, Central Water & Power Commission.
PROF. M. S. THACKER,
Director, Council of Scientific & Industrial Research and Ex-Officio Additional Secretary, Ministry of Natural Resources & Scientific Research.
SHRI S. B. BAPAT,
Joint Secretary, Ministry of Home Affairs.
SHRI S. RANGANATHAN,
Joint Secretary, Ministry of Works, Housing & Supply.
SHRI K. N. SUBRAMANIAN,
Joint Secretary, Planning Commission.
SHRI K. P. MUSHRAN,
Member, Staff, Railway Board.

*SHRI H. P. MATHRANI,
Joint Secretary, Ministry of Transport.
SHRI G. K. CHANDIRAMANI,
Special Officer, Ministry of Education.
DR. B. D. KALELKAR,
Industrial Adviser, (Engineering), Ministry of Commerce & Industry.

Secretary :

SHRI B. N. DATAR,
Director, Labour & Employment, Planning Commission.

3. The Committee, under the powers given to it, co-opted the following additional members :

SHRI N. GOVINDARAJAN,
Retired Chairman of the Union Public Service Commission.
SHRI H. DAVENPORT,
Director, Employment Exchanges, Ministry of Labour.

4. The terms of reference of the Committee are :

1. To make a general assessment of shortages of supervisory and higher grades of engineering personnel anticipated at the end of the first five year plan ;
2. To estimate the probable requirements of engineering personnel of supervisory and higher grades for implementing the second five year plan in the principal fields of national development such as building and road construction, railways, industrial development in the public and private sectors, mining and irrigation and power etc. ;
3. To review the programme of the Central and State Governments under the second five year plan for the expansion and development of facilities for technical education for engineering personnel of supervisory and higher grades and to recommend such additional or modified programmes as may be considered necessary ;
4. To review existing facilities for practical training in industrial establishments, including apprenticeships and to recommend measures for their expansion in co-operation with industry ; and
5. To make such other recommendations as may be essential for ensuring the adequate supply of engineering personnel for the next fifteen years with particular reference to the immediate requirements of the second five year plan.

5. The Committee sent its interim recommendations to the Planning Commission on 19th January, 1956. These included steps for augmentation of training facilities, improvement in the schemes of training and other organisational and policy aspects relating to engineering personnel. In the present Report, the Committee have taken into account the comments on their interim recommendations and also modified to some extent their assessment of the problem in the light of additional information received during the last two months.

6. The Committee collected information relating to the demand for engineering personnel from Central Ministries, States and the private sector. On

* Shri H P. Mathrani could not join the Committee. His place on the Committee was taken by Shri H. P. Sinha, Additional Consulting Engineer (Roads), Ministry of Transport. The Report has, therefore, been signed by Shri Sinha.

the supply side, data available with the Ministry of Education and the Directorate General of Resettlement and Employment, Ministry of Labour, have been used. To analyse the information on demand, the Committee held meetings with the Ministries concerned. The officers of the Committee visited some States and held discussions with the authorities there in order to assess the demands of the States. In the case of States which could not be visited, information supplied by them was used with such modifications as were considered necessary in order to introduce a measure of uniformity in the estimates. The Committee had the benefit of discussions with Shri A.N. Khosla, Vice-Chancellor of the Roorkee University and Mr Guy Moffat, one of the advisers of the Technical Cooperation Mission and who was for a long time connected with man-power problems in the United States. The Committee held meetings with the Builders' Association of India, Bombay, the Indian Engineering Association, Calcutta, the Engineering Association of India, Calcutta and the Institution of Engineers (India) and discussed with them the Committee's interim recommendations and also generally the method of assessment used in arriving at estimates of demand.

7. At the first meeting of the Committee, a sub-committee consisting of engineer members was constituted to give technical guidance in the examination of the information collected. The deliberations of this sub-committee were very useful for assessing the demand and drawing up the recommendations for augmenting supply.

8. The work of the Committee was considerably facilitated by the willing co-operation of the Ministries and the State Governments. In particular the Committee would like to express its thanks for the valuable assistance given by Shri R. Ramamurti of the Ministry of Education; Sarvashri M. Hayath, R.D. Dhir and M.G. Hiranandani of the Central Water & Power Commission; Shri D. Padmanabhan of the Council of Scientific and Industrial Research; Sarvashri V.T. Narayanan and M.N. Bery of the Ministry of Railways; Shri D. G. Bhagat of the Roads Wing, Ministry of transport; Sarvashri C. B. Patel and Nargolwala of the Ministry of Works, Housing & Supply and Sarvashri P. C. Suri and V.Y. Narayan of the Planning Commission. The Committee would also like to place on record its high appreciation of the services of the Secretary, Shri B.N. Datar. But for his zeal and untiring industry, it would not have been possible for the Committee to complete its assignment within the time at its disposal. Thanks are also due to Shri A.S. Nagpal, Shri N. Ananthanarayanan, Miss K. Nayar, Shri J. R. Chhabra and other members of staff who spared no pains in rendering to the committee assistance in regard to work connected with administration and research.

CHAPTER II

HISTORICAL PERSPECTIVE AND FUTURE TRENDS

9. In our country, the development of irrigation, power and road and rail transport constituted the bulk of engineering activity for many decades. Since the designing and manufacture of important structures and machinery were carried out by engineers abroad and top supervision of heavy works executed within the country was also entrusted to foreign personnel, the demand for engineers was then restricted to branches of civil and electrical engineering. Early institutions like the Engineering School opened at Guindy in 1842 and the Thomason Engineering College established at Roorkee in 1847, though then equipped to meet this somewhat restricted need, now offer diversified engineering training. The colleges subsequently opened followed the same pattern. Again, as in other countries, institutional training started with civil engineering and courses in mechanical and electrical engineering followed later. Provision of further specialised and advanced courses in various fields is, however, a recent development in India. As a result, we have at present engineering institutions imparting instruction at different levels in a number of branches. The total out-turn of graduates and diploma-holders from these institutions in 1954 was 2,904 and 2,965 respectively (Details in Table I)

10. While engineering education started more or less at the same time in India and in western countries like the United Kingdom and the United States, progress in India was slow and was restricted to the minimum needs of the situation. This was more so in branches other than civil engineering. It was the Second World War which forced the pace of technical education. There was a sudden demand for articles manufactured within the country and this made necessary the training of a number of skilled craftsmen. Existing institutions were expanded and new ones were opened. Vast quantities of machinery and equipment had also been brought into the country during the War. Many young men who would not otherwise have embarked on a technical career found their opportunity and obtained training in engineering trades. The prejudices and obstacles against industrial employment were steadily overcome. The need for organised research was also felt owing to the shortage of imported articles and the consequent demand on indigenous products. With the advent of Independence, a number of national laboratories were established, including institutes for engineering research. The Indian Institute of Science, Bangalore was developed for advanced instruction and research in a number of engineering fields and the first Higher Technological Institute was set up at Kharagpur. Under the first five year plan, such facilities were further developed at selected training institutions.

11. Equipment brought into the country and the skills developed during the War formed a vast reserve of men and materials to start technical institutions of all grades at the end of the war in different parts of the country, but not all of them were able to maintain the requisite standards. Particularly in case of diploma institutions, the capacity has increased without a corresponding strengthening of staff or equipment. The basic structure of the engineering colleges also appears to have undergone little change over the decades by way of adaptation to modern needs. Since it was difficult to expect each State to maintain a department capable of inspecting and advising higher technical institutions, the All India Council for Technical Education was brought into being by the Government of India in 1945 to control policies

relating to technical education. Largely as a result of the endeavours of this body and its regional committees, gradual progress is being made both in ensuring minimum standards and in giving direction to the pattern of instruction to suit our changing requirements.

12. In the matter of skilled workers, under the war-time technical training scheme, young men were recruited to defence services and also to civilian industries engaged in supplying military requirements. After the War, some of these men were retained in defence services and ordnance factories and a few others were absorbed in civilian industries. The war-time training centres were utilised for the benefit of ex-servicemen and consequent to Partition, the same centres were adapted to train displaced persons.

13. The unusual increase in the number of training centres for skilled workers during the last decade has brought to the forefront the problem of recruiting and training craft instructors. The shortage of trained instructors was so serious during the War that India had to secure their services from the United Kingdom to train war technicians. In 1948, therefore, the Central Training Institute for Instructors was opened at Koni (Bilaspur) by the Ministry of Labour and some more institutes on the same lines are proposed to be set up in the next five years.

14. It would now be appropriate to examine how the activities which demand engineering personnel have grown in recent years and are likely to grow in future in order to provide a perspective for analysing the supply and demand for such personnel in the coming years. An idea of the expansion of engineering activities in the country since 1938 can be had from the following table:

Expenditure of the Central & State Governments on certain engineering items/ during selected years.

	1938-39	1945-46	1950-51	(Rs. crores) 1955-56** (Budget estimates)
1. Civil Works	10 . 19	19 . 16	68 . 39	115 . 90
2. Industries	1 . 43	5 . 11	26 . 87	52 . 23
3. Irrigation	3 . 23	5 . 24	49 . 36*	160 . 61*
4. Electricity	1 . 26	0 . 80	25 . 67	61 . 40
5. Railways	16 . 13	29 . 77	63 . 20	128 . 15
Total :	<u>32 . 24</u>	<u>60 . 08</u>	<u>233 . 49</u>	<u>518 . 29</u>
Total adjusted for rise in price level as indicated by the Index Number of Whole sale prices with base year 1939-100	<u>32 . 24</u>	<u>24 . 52</u>	<u>56 . 94</u>	<u>137 . 84</u>

Source : "Combined Finance and Revenue Accounts of the Central & Provincial Governments In India" (Issued by the Ministry of Finance.)

15. It would be seen that the activities in the public sector which demanded engineering personnel increased more than four times during the last fifteen years, after allowing for price changes during the period. In

* Including expenditure on multipurpose river valley schemes.

** Includes expenditure of Part 'C' States

the private sector too, engineering activity has increased, as would be seen from the growth in the total paid-up capital of companies in certain selected, engineering trades like transport, chemicals, iron & steel, ship-building, engineering, electricity, water, gas, telephone etc. In these trades, the paid-up capital as revealed by the publication of the Ministry of Finance "Progress of Joint Stock Companies in India", has gone up three times during the same reference period. The quantities of cement and steel consumed in the country provide other indicators of engineering activity. Production of cement has increased from 1.4 million tons in 1938 to 4.4 million tons in 1955. The target of cement production to be achieved by 1961 is 10 million tons. The demand for steel has also gone up three times in the last 15 years. It is expected to increase by another 70 percent during the period of the second plan. Another important factor which is likely to affect the entire range of engineering activity in the coming years is the development of nuclear energy for peaceful uses. In countries which are developing atomic energy, installation and working of atomic reactors are known to demand a large complement of highly qualified engineers and ancillary personnel in comparison with other fields of power development. While it may be difficult to visualise at this stage the exact scope of the utilisation of nuclear energy, any significant progress here might necessitate a re-appraisal of the demand situation relating to engineering personnel.

16. As has been stated earlier there has also been considerable expansion in the facilities for training of engineers in recent years. A direct comparison of this increase with the corresponding expansion in engineering activity would show that, on the whole, supply has not kept pace with demand. Again, such a comparison does not take into account the regional aspects of supply and demand. It may happen, for instance, that a qualified engineer would rather under-utilise his skills than migrate for insufficient incentives and a regional imbalance may develop. Further, owing to a number of factors, the demand for qualified engineers for a certain level of engineering activity has itself been increasing with the diversification of such activity. The withdrawal of foreign engineering personnel has added to the shortages. The very fact that the economy has been able to absorb all the increases in the technical training facilities and is still wanting to have more is a further evidence of existing shortages. The information received by us in respect of existing shortages is compiled in Table II. It will be seen that shortages are experienced even in the regions where the training facilities are sufficient to satisfy regional demand. Such a development is, perhaps, the result of "flight of personnel" which is discussed in a separate chapter.

17. Creation of additional permanent facilities for engineering instruction to fill the gap would largely depend upon the continuance of a high level of demand for engineers over a longer period than the next five years. In this connection, a consideration which has to be kept in mind is the importance that we may have to attach to the place of construction in providing employment. During the second five year plan, construction employment will be of the order of two million additional jobs. Even with all the employment that we might create during the second plan period, the unemployment position is expected to remain substantially what it is at present and would need greater effort in the third five year plan. Construction activity will, therefore, continue to enjoy the same importance in the third plan as in the next five years. Moreover, with large increases in the production of cement, iron and steel etc., and the emphasis on machine building activities that we would be laying in future plans, the demand on engineering personnel could be sustained at a fairly high level. It is in this context that we have to view the conclusions reached in the subsequent chapters.

CHAPTER III

ASSESSMENT OF DEMAND

18. We have been asked to analyse the position relating to the demand and supply of supervisory and higher grades of engineering personnel. Posts at these levels in the public sector are occupied mostly by engineering graduates and diploma holders in engineering; also to a small extent by persons with non-engineering qualifications ranging from matriculation to a science degree and who have received departmental or workshop training. In the private sector, the practice has been to get most of such work done by persons who have risen from the ranks. In-plant training is bound to play an increasing role in future years in adding to the nation's resources of engineering personnel. Recognising that such training is not at present organised in an adequate measure, we have made recommendations elsewhere in the Report in regard to its expansion. At the same time, it is not possible to determine numerically the quantum of training facilities likely to be made available in this manner. Indeed, each of the large number of industrial units is a training centre by itself and new facilities are expected to spring up with the growth of industry. We have, therefore, confined our numerical assessment to persons who need institutional training in engineering.

19. The term "engineering graduate", for the purpose of our Report, is understood to mean not only those who possess engineering degrees of recognised universities, but also those who hold diplomas which are in reality equivalent to or even higher than engineering degrees. For instance, the diplomas awarded by the Indian Institute of Science, Bangalore, the Madras Institute of Technology, the Institution of Engineers (India) etc., have been recognised by important employing authorities, public and private, as equivalent to degrees. The term "diploma holder in engineering" includes all those who, after matriculation or equivalent examination, have successfully undergone engineering courses of at least two years' duration, reaching a standard of theoretical instruction attained by licentiates in engineering.

20. Though assessment of the demand for skilled workers does not fall within our terms of reference, we feel that such workers form a vital component of technical manpower resources and that their inadequate supply could develop into a critical bottleneck in the implementation of development programmes. We, therefore, consider it necessary that there should be as much planning in the organisation of their supply as in that of personnel belonging to the supervisory and higher grades.

21. In all such assessment, it is fairly easy to get a reasonably reliable picture of the supply position. Projection of demand, besides being more complicated, involves a number of basic assumptions. For example, in any over-all assessment of this kind, a reasonable measure of regional mobility is implied. Under existing conditions in our country, this assumption is of doubtful validity, especially at lower levels. Even the engineering graduates who are willing to go anywhere soon after their graduation from universities, develop a resistance to being moved away from their homes, after gaining initial experience. Such difficulties are likely to increase, since education in States will be imparted more and more in regional languages and movement of officers with children of school-going age between regions may result in dislocation in the children's education. For these reasons, we feel that the regional aspect of demand and supply has to be kept in mind.

22. The mode of execution or the relative emphasis placed on the use of manual labour as against mechanical equipment has an important bearing on personnel requirements at different levels. In recent years, construction work generally has not undergone substantial technological change, though increased mechanisation is visible in large-scale building activity in metropolitan areas and on big engineering projects. In the light of the evidence before us, it has been assumed that in the next five years, no major change is likely to take place in the existing pattern of the relationship between men and machinery as would seriously affect the requirements for engineering personnel.

23. The demand is also likely to vary according to the agencies for design and construction. It is necessary, in this connection, to consider the manner in which construction work is carried out under different agencies. Simple works of an ordinary character demand simple designs of a repetitive kind which are prepared in the engineering departments and are executed by contractors, who are available for such works. The execution of these works does not involve the use of qualified engineers to any considerable extent. On the other hand, major works of a highly complex nature require special skill both in design and in execution. The design is undertaken largely by government engineers and where contracting firms can offer designs, the responsibility for passing them will still rest with the departments. Contractors capable of executing large works in the fields of river valley development, road and railway construction and building activity have been entering business in increasing numbers to meet the growing needs.

24. The demand for supervisory personnel would not be very different whether the works are designed and executed by the department or by contracting firms. However, the greater flexibility which the firms have in recognising merit and maintaining cost accounts, might mean a slightly lower demand. On the other hand, a work is better accounted for to the public if executed departmentally. In the immediate future, however, departmental work is not likely to expand in view of the growing tempo of construction and the paucity of supervisory personnel. Our view in this respect is also borne out by Government's proposal to set up a National Construction Corporation which will function on the pattern of contracting firms. All these factors which enter into the assessment of personnel demand are difficult to judge individually and we have, therefore, made a suitable allowance for them in our estimates in consultation with expert opinion in the country.

25. For collecting information on the demand for engineering personnel during the second plan period Form E. P. I (Appendix B) was issued to the Central Ministries, States and other employing organisations. The reporting authorities were requested to indicate on it shortages as were likely to prevail on the eve of the second five year plan i.e., as on March 31, 1956 in different categories of engineering personnel and the recruitment which would be necessary during each year of the second plan period. Besides the form questionnaires (Appendices C, D and E) were also issued with a view to collecting information on various aspects of personnel planning and on measures so far initiated by them to resolve their difficulties. While completed returns were received from almost all Ministries and States regarding higher categories of personnel, viz., graduates and diploma holders, the information about skilled workers was not in a form in which it could be conveniently used. The demand for such personnel, therefore, had to be separately considered.

26. Estimates of demand have been computed largely on the basis of the cost involved in different schemes proposed to be executed under the second plan. For instance, in working out their demand estimates, the

Military Engineering Service, the Public Works and other departments have largely proceeded on the basis of anticipated programmes, and their past experience regarding the work-load which each construction division consisting of a given number of engineers, overseers etc., could handle. As a result of discussions with the Ministries, the Committee arrived at certain "norms" or yardsticks for calculating engineering personnel requirements in sectors of development like roads, buildings and irrigation projects for which the State Governments had allocated substantial amounts in their plans. These norms were expressed as ratios between the expenditure involved and the personnel required and were meant to be of some use to the States in estimating their personnel demands. While States were in general agreement with these yardsticks, it was explained by some of them that correction factors would have to be applied to the norms suggested by the Committee, if they were to correspond to conditions in different regions. States have largely drawn on their past experience with regard to work in different departments to evolve these correction factors. We have accepted their yardsticks wherever they were supplied and where these did not significantly differ from the norms drawn up by us. Where States failed to furnish returns, the yardsticks in vogue in adjacent areas have been applied to the anticipated development expenditure in the concerned States to arrive at estimates of personnel requirements.

27. There are other reasons why standard norms cannot be used throughout the country. The number of engineering personnel required to execute works of a given expenditure differ from sector to sector; they also vary within the same development sector according to the type of work envisaged. For instance, it has been brought to the notice of the Committee that in the railways, the composition of engineering manpower required for a certain amount of expenditure on new lines will be something quite different from the personnel for the same expenditure on doubling of existing lines. Again in all fields of development the number and the levels in which engineering skills are required are different for construction work as distinguished from maintenance work. While for planning and construction more officers at higher levels are needed, engineering subordinates are required in larger numbers for maintenance operations. The extent of geographical concentration or dispersion has again a bearing on personnel requirements in as much as the incidence of supervision would be greater and a larger number of supervisory personnel would be required if the works are scattered, than if they were located in the same area.

28. In terms of expenditure, most of the civil works under roads, buildings, irrigation and public health are normally executed through contractors. Though the major portion of such work is handled through contractors who do not employ graduates or diploma holders in large numbers, the work which goes to established firms is quite considerable. In making our calculations for the private sector we have assumed that the present pattern of distribution of work between departments and contractors and as between big contractors and others will continue in the second plan also.

29. There are certain areas of operation like the mechanical department of railways, where the "cost to personnel ratio" does not help in estimating demand. For instance, where costly automatic machinery is installed, it often happens that with increased expenditure, less men are required. In all such cases where the expenditure approach to demand estimation is inapplicable, the production targets have been used by estimating authorities as a basis for computing demand.

30 In the case of architects, the demand as shown by States for a given expenditure was much below the standard suggested by the Central Public Works Department. This was because the States utilised the services of engineers where architects were needed. The specialised functions of an architect, however are being increasingly realised as would be seen from the large demand for them outside the public sector. We do not, therefore, consider the data available with us as a sufficient indication of the demand on architects. Though on the basis of our calculations there seems to be a more than adequate supply at present, it may be necessary to review the position in this regard in the near future.

31. For assessing the demand for engineering personnel to execute that part of the second plan which covers industries in the private sector, we did not find it possible to collect detailed information from industrial employers. We, therefore, relied upon estimates made by the Development Wing of the Ministry of Commerce and Industry with reference to personnel requirements of almost all the industries, for which expansion plans had been drawn up. These calculations are based mainly on the experience of development officers dealing with different industries and the manpower data supplied by applicants for licences under the Industries Development and Control Act. Estimates worked out in this manner, perhaps, do not have the same validity as those in other fields of developmental activity.

32. It has been pointed out to us by one of the associations in its evidence that the overall assessment as planned by us was insufficient and that much detailed work would be necessary to estimate requirements of engineering personnel for each industry separately, if the picture that we sought to build was to have any validity. While we recognise the force of this argument, we do not consider that at this stage, anything beyond an overall assessment is called for. We recommend that the Development Wing of the Ministry of Commerce and Industry should pursue this matter further.

33. The existing pattern of engineering employment in the private sector reveals an inadequate complement of graduate engineers as against a disproportionately large number of personnel with lower levels of training. Except where precision work is involved, the private industrialists prefer to recruit men at the supervisor's level on low salaries and utilise their services for higher executive work as well, after giving them practical training. It was pointed out to us by one of the associations that even in the recruitment of supervisors, they would prefer persons who have come from the ranks. This was probably because men who came from the ranks were cheaper, stuck to their jobs better and were more amenable to contractors' discipline. The reluctance to employ qualified persons in private industry is a heritage of the past and is also based on an allegation, unfounded to a large extent, that a qualified engineer often preferred not to soil his hands. We have noted with satisfaction in the evidence placed before us that there has been a gradual change in this attitude both on the part of graduate engineers towards the work they are expected to do and also on the part of employers in recognising the utility of qualified engineers. We anticipate that private industry will soon demand such personnel in larger numbers. Again, at present the demand for competent engineers for conducting research in private industry is negligible, since such work is still in its embryonic stage. In a later chapter, we have made specific recommendations for encouraging research which will lead to a greater demand for engineering graduates in the private sector. Our demand estimates for the private sector are based on this changing end and not on the existing pattern of graduate employment.

34. A large number of qualified engineers will be required in the next few years both to staff the engineering institutions proposed to be opened as part of the second plan and for creating the additional facilities we have

recommended. The probable demand for different categories of engineers who will be required in this regard has been worked out by the Committee in consultation with the Ministry of Education and is incorporated in the demand estimates. Multi-purpose schools to be opened during the second plan period are also likely to need a significant number of diploma holders to handle courses in engineering subjects offered in such schools. In our overall calculations, we have taken into account personnel requirements for this purpose.

35. Suitable allowance has been made in the Committee's estimates to account for vacancies resulting from retirements and deaths. Wastage due to superannuation depends upon the "age" of the department. While in an old department like the railways, wastage on this account may be considerable, in entirely new departments it may be negligible since most of the employees will be young recruits. The Ministries and State Governments were requested to take these factors into account in working out the replacement demand arising out of retirements and deaths. Allowances for leave and deputation reserves have also been made by reporting authorities according to rules in force in their respective departments.

36. Central Ministries and State Governments had indicated comparatively heavy demands in the initial years of the second five year plan; they had planned to cover their existing shortages of personnel as early as possible. Also, at the time of estimating their demands they had budgeted for a heavier expenditure in 1956-57 as compared to that in 1955-56. Subsequently, the Planning Commission advised the States not to exceed in 1956-57 the level of expenditure attained in 1955-56. While in the case of certain priority projects concentration of personnel demand in the initial years was unavoidable, in view of the nature of the work and the strict time schedule for completion arising out of its importance, the Committee felt that insistence on the part of every department to have the bulk of its personnel demands satisfied in the first few years of the second plan would create a 'hump' in the demand curve, which it would be impossible to negotiate. The existence of the 'hump' is due to difficulties in the past of anticipating the nature and extent of future development. Apart from these considerations, there is no time left for training the engineers required to be in position in the early years of the second plan. Again, expansion on a permanent basis of the training facilities to meet such situations of heavy demands in isolated years can only be bad planning. This point was explained by us to the representatives of the Ministries and the States with whom discussions were held and the authorities concerned conceded the need for gradual phasing. We have, therefore, rephased the demands to correspond to a more realistic increase in the total personnel requirements of different departments over the next five year period. This has been done by so redistributing the demand that the current shortages or the present overloading on existing engineers will be reduced over the five year period. Without such a distribution of personnel between the different sectors and between the five years of the second plan, it is not possible to arrive at any estimates for augmenting training facilities immediately. This distribution should not, however, be construed as an actual allocation of personnel as between (a) the private sector and the public sector and (b) within the public sector itself, between Central Ministries, States, Public Corporations and Local Bodies. All that we are expected to do is to secure an adequate supply of engineering personnel at an early date.

37. During discussions in the Committee, it was revealed that the

planning machinery in some States had not yet developed to a stage where the phasing suggested by them could be considered realistic. In view of this and also since the phasing for the private sector of industry had been worked out by the Committee on the basis of information available for only a limited number of industries, we consider it necessary to emphasise that the demands on personnel as have been phased by us are likely to be less firm than the overall estimates.

38. Our estimates include personnel requirements for construction as well as maintenance work. In calculating the maintenance needs in a factual assessment of this kind, care has been taken to allow for the fact that maintenance standards as prevailing in the public sector are not necessarily adhered to in the private sector.

39. While a part of the construction personnel in a particular project is often absorbed in the same project for maintenance work, in a majority of cases, the surplus personnel require to be found employment elsewhere. This situation is not likely to create problems so long as the total engineering activity in the country is maintained at a sufficiently high level. What is more, we have also to assume that such accelerated pace of construction would continue for many years to come. This implies, however, sufficient mobility of personnel and a suitable deployment machinery to coordinate the release of personnel from one project and their absorption in another. The point has been mentioned here since it has an important bearing on the assessment of demand. The steps to be taken for constituting a deployment machinery have been discussed elsewhere.

40. In attempting a sector-wise break-up of demand estimates, the Committee was handicapped by the fact that in most States, the Public Works Department looked after different branches of engineering activity like road development, building construction and public health engineering. Similarly, contractors who executed a major portion of civil works in different fields of development find it hard to define the engineering personnel required by them separately for their different activities. In view of these difficulties and the fact that sector-wise demand has no particular relevance to the organisation of additional training facilities, the Committee thought it best not to attempt such a break-up. The Committee's estimates of all India demand for the plan period, region-wise and ministry-wise, are shown in Table III. Details of the phased demand are shown in Tables IV to XIX.

41. As has been pointed out earlier, it is necessary to view the demand and supply of engineering personnel on a regional basis. In spite of the incentives that would be thought of for promoting mobility, there will always be resistances which will throw any overall assessment out of gear. We have, therefore, considered it necessary to distribute the total demand between different regions of the country. For this purpose, we have adopted the four regions for which the All India Council for Technical Education has its committees. In estimating the demands in this manner, we have assumed that the demands of the States will be fully met from within the region in which they are situated. As to the Central projects located in particular regions, our assumption is that their personnel requirements will largely be met locally depending upon available supply and the nature and magnitude of developmental effort in the region. The requirements of the Ministries of Communications, Railways, etc., whose works are spread all over the country, have been distributed equally among the four regions. The contracting firms again do not respect any regional boundaries for attracting their personnel. In their case also, the total demand has been equally distributed. The requirements of engineering personnel for private industry have been allocated according to the industrial importance of different areas.

CHAPTER IV

REVIEW OF SUPPLY

42. While it may be stated as axiomatic that training for the engineering profession must include in its scope both theoretical instruction and practical work, the order in which these are imparted may vary according to needs. No rigid method can thus be prescribed for engineering education. In India, institutional training has so far played a dominant part in supplying the requirements for engineering personnel, though in countries in the West, part-time courses for industrial employees have been as important as institutional training in developing engineering talent. Successful experiments are also carried on in what are known as "sandwich" courses, where the student alternates periods of full-time instruction in a college with similar periods of practical work in industry. Though the end products of these different modes of instruction, leading to professional status, as engineers, possess somewhat different characteristics, their blending is believed to have benefited the engineering activity considerably.

43. We have utilised the annual statistics collected by the Ministry of Education for reviewing the supply position relating to engineering personnel from teaching institutions. Forecasts of future out-turn (Tables XX, XXI) have been made after taking into consideration additions to existing capacity, proposals for which have been included in the Draft Outline of the Second Five Year Plan* and allowing for a wastage of 20% on annual in-take,

44. Information on the nature and extent of technical training facilities available in industrial undertakings in both the public and private sectors has been collected by the Directorate General of Resettlement and Employment. The Directorate has been attempting, for some time past, to bring out a comprehensive hand book on technical training facilities in the country, both institutional and in-plant. The information obtained from them shows that in industrial establishments which offer apprenticeship courses in engineering trades, the level at which training is offered, the minimum qualifications required for admission, the period of training, the practical training given etc., vary so much that no useful conclusion can be drawn from any arithmetical addition of output figures. Even so, the Committee have tried to present a picture (Table XXII) which conveys to some extent the broad scope of in-plant training facilities in engineering trades.

45. For a large number of skilled engineering occupations like blacksmithy, masonry, carpentry etc., training is often imparted from father to son in the course of actual work. Neither finance nor organisation is involved in such training, which has in it the further advantage of flexibility. It has not been possible to assess the supply position relating to such categories.

46. Some Indian nationals go abroad for both graduate and advanced training in engineering. During the last few years, the number of such students has remained more or less stationary at around 200. To the extent this number includes persons, who before leaving the country did not have basic engineering qualification, this would mean an addition to our personnel resources. A small number of engineers who get trained in this manner settle down to jobs in countries like the United Kingdom and the United States,

There has been no change in these proposals since the publication of the Draft Outline.

where at present shortages of engineers are badly felt. Some of those who are employed in this manner are trained in specialisations which are not required in the country at present; there are others whose skills are needed here, but who settle abroad where they find better opportunities. We should, therefore, aim at making the expensive foreign training more purposeful by an advance mapping of fields in which such training is needed and earmarking persons for suitable positions in the country on their successful completion of training. In this connection, we would like to record the offer made by the Technical Co-operation Mission that if a forecast of our requirements for places in training institutions abroad could be made in advance, it might be possible for them to secure a more effective utilisation of their resources and those of other technical assistance organisations towards meeting our requirements. Further, scholarships for foreign training should be given only for specialisation in urgently needed techniques and that too, on condition that the services of the trainees will be placed at the disposal of the country at the end of the training period. A larger proportion of these scholarships should be made available to teachers in engineering institutions. Simultaneously, attempts should be made to provide post graduate facilities in the country on a wider scale.

47. There is not sufficient justification for the apprehension felt in certain quarters that proper use is not being made of our foreign trained engineers and that as a consequence, they are forced to accept positions which do not utilise their special talent. We have reasons to believe that in most cases, these engineers do get suitably placed sooner or later. This is not to suggest that there are no cases of maladjustment. These are often due to the fact that the men have qualified themselves in specialisations for which no demand has developed in the country so far. However, the possibility of a demand arising in the near future for these very skills cannot be ruled out. We, therefore, recommend that in sectors where development is anticipated and qualified personnel will not be useful unless they have suitable experience, it may be necessary to afford facilities to these engineers for advanced work and research by creating (a) design and development wings attached to state enterprises and (b) extra posts in the engineering and technological institutions, financed if necessary by the Centre. We would like to add that these facilities should also be extended to engineering students who have undergone training within the country in specialisations for which demand is likely to develop. This procedure will ensure that the specialised knowledge acquired by our engineering students does not get lost to the country when it is wanted.

48. In posts requiring advanced technical knowledge, dependence on foreign "know-how" and aid is giving place to gradual self-sufficiency. While this process goes on, foreign experts who are sent out to this country under various aid programmes and the consultants and technicians who come over here to erect plant and machinery purchased by us continue to constitute an important source of engineering manpower at the critical top level. The Committee have felt it impossible and unnecessary to assess the supply and demand position in respect of these personnel - impossible, because it is subject to a number of extraneous and uncontrollable factors and unnecessary, because it does not involve any training arrangements within the country.

49. The degree of specialisation in engineering education is an aspect of training which has been widely discussed in recent years. An engineering student can either become an acknowledged specialist in a very narrow field or alternatively, he can acquire a broad understanding over a wide range of applications. In the United States, for instance, it is very often the case now-a-

days that a man attempts to concentrate his study and training into one particular and necessarily limited sphere, because he knows beforehand that within that sphere he can make a career for himself and advance step by step. In spite of significant industrial progress registered in the country in recent years, we feel that in India the time has not yet come when a steady and continuing demand for specialists in narrow fields of application may be said to have developed. It will, therefore, be more advantageous for our institutions to continue the present method of engineering education under which accent on a selected branch follows an initial period of comprehensive basic engineering training. As it is training in all branches has tended of late towards some specialisation. This naturally will have to continue; but what we suggest is that there should be no conscious effort at narrow specialisation, which should be appropriately left to the post-graduate stage. Too early specialisation at the expense of breadth of knowledge will result in the restriction of a man's ability to accept responsibilities which, under current conditions in the country, are likely to cover wider fields as the engineer advances in his career.

50. It is not possible to assess with any degree of accuracy the demands that are likely to arise in the next five years for specialists. It is recommended that the needs for such personnel could be met as and when they can be foreseen, by deputing the required number of engineers for training either within the country or abroad. The training requirements for specialists are, by their very nature, related to the actual circumstances of each case and cannot be fitted into defined courses of specific durations, until such time as sustained and considerable needs for particular categories and standards develop to warrant the organisation of regular courses.



CHAPTER V

THE QUALITY OF ENGINEERING PERSONNEL

51. The strength and effectiveness of our future development will depend, to a large extent, on the quality of engineering personnel available for absorption. No efforts should, therefore, be spared in achieving a high level of competence in engineers who will be trained by various methods during the coming years. This is specially necessary, in view of the fact that the responsibilities which engineers in our country have been asked to shoulder in the post-Independence period are considerably greater than those which devolved on them in the earlier years. We have no doubt that, on the whole, our engineers have risen to the occasion and acquitted themselves creditably. Indeed, some of the associations of employers interviewed by us testified that there has been no change in the quality of products of engineering institutions. They referred to some institutes where the teachers had instilled in the trainees the commendable spirit of dignity of labour and an awareness that the education they received fitted them for *work* and not for a *job*. At the same time, we cannot fail to take cognisance of complaints voiced before us from some quarters about recent deterioration in the quality of engineering personnel turned out by our institutions. Corroborating evidence is available in the experience of the Public Service Commissions. Our assessment of the situation is that while standards in respect of the top students in different institutions have been maintained, average standards indicate some falling off. This lowering of standards in engineering colleges is attributable to a number of factors, the more important among them being dearth of teachers of the right calibre, inadequate facilities for practical training, ineffective methods of examination and enforcement of standards and possibly also insufficiency of equipment in some of the institutions. These are discussed in some detail in the following paragraphs and suitable remedies suggested.

52. The pay and prospects held out by educational authorities do not match the offers made by Government and industry to trained engineers and as a result, men of calibre are diverted away from universities. It has been noticed during the last few years that fresh engineering graduates who join teaching institutions leave for better posts after two or three years. While colleges serve them as stepping stones for a future career, students suffer as a result of uncoordinated instruction by fresh batches of raw graduates who treat employment opportunities in the teaching profession only as stop-gap. It has been brought to our notice that it has not been possible to attract the right men even in universities which offer comparatively high salaries. An idea of the disparity in salary scales between universities and Government can be had from the fact that principals of engineering colleges, who reach that position after long years of service, are paid a salary normally drawn by an executive engineer under Government. Further, the present staff set-up in universities guarantees no promotion even for meritorious men and the many instances of competent teachers who have remained stagnant in the positions of their first appointment deter able engineers from seeking service in educational institutions. It is true that there are powerful inducements other than financial rewards in the university way of life, but unless salary scales and other service conditions are brought up to a reasonable level, the teaching profession will continue to be the last resort of employment seeking engineers.

53. We, therefore, recommend that service conditions for teaching staff in engineering institutions should be brought on par with those obtaining in executive positions under Government. If this is done and a normal line of promotion opened up in the teaching career, possibly by mutual exchanges on a deputation basis with engineering services under Central and State Govern-

ments, there is no reason why teaching institutions should not be able to attract some of the best engineering talent in the country. In places where it may not be possible to effect such coordination, an attractive salary range should be tried as an alternative.

54. We feel that in the recruitment of teachers, practical engineers with a flair for theory should be given preference. In this connection, the need for Government to spare competent men from their engineering cadres for the colleges, even if this meant a temporary shortage of experienced personnel for their development programmes, cannot be over-emphasised. We attach great importance to the adequate supply of well qualified and experienced instructors and would like to point out that hesitation on the part of Central and State Governments and even private firms to spare the necessary men for this matter will be a short-sighted policy and will only perpetuate shortages of engineers. This does not mean that fresh graduates should be excluded from teaching posts. They should, however, be given suitable training immediately after recruitment; even after posting, they should be made to undergo refresher training at periodic intervals.

55. To help college teachers to keep in touch with the progress taking place in engineering practice, field experience should be frequently arranged in industrial enterprises and engineering projects. This will enrich their knowledge with wider experience, which in turn will enhance the quality of their instruction in the class rooms and laboratories. Our recommendation is applicable the other way round also, viz., to serving engineers who should be sent to colleges for refresher courses to keep them abreast of modern development in theory and design. In the United Kingdom and other countries, there is planned cooperation between industry and universities in the matter of technical training and education with a view to giving the country's technical personnel the best that is available by way of training opportunities. The Massachusetts Institute of Technology and the California Institute of Technology in the United States organise courses in collaboration with leading industrial houses like the General Electric, Westinghouse etc. Students who take these courses spend six months in an educational institution and six months in industry. While the student works in industry, he is also given evening courses to keep him up-to-date in his studies. On the other hand, several companies have set up training programmes for the benefit of their employees in conjunction with nearby universities, either utilising the facilities and staff of the universities or bringing instructors into the plant itself. The business house of Westinghouse is stated to have a University Relations Department which directs an employee educational programme in cooperation with eleven major universities. The Polytechnic Institute of Brooklyn has employees of more than a hundred companies taking engineering courses. Government departments in America have their own in-training programmes for employees to fit themselves for advancement within the department. These schemes are stated to be very successful. Germany's remarkable technological developments during the period 1850-1940 were due in part to "close personal cooperation between the university institute directors and the leaders of industry." Many distinguished German industrial scientists hold honorary professorships in German universities and lecture regularly.

56. In this context, we welcome the establishment of a centre at Roorkee to provide training facilities to serving engineers in the techniques of development of water resources. It will be of interest to know that this centre has not only been training Indian engineers, but also those deputed for training by a number of Asian and African countries. We also note that the existing arrangements in the Central Water and Power Commission for imparting specialised training to about 45 engineers every year in the

designs and methods of construction of dams and power plants will be continued.

57. It has been pointed out to the Committee that in view of the large works programmes under implementation in the States, it would not be possible for them to spare their engineers for refresher training. This difficulty has also been cited by the States in deputing engineers to local bodies and other agencies whenever requisitions came from the latter sources. We, therefore, recommend the strengthening of the cadres to allow for a "reserve for refresher training and deputation" of six percent, out of which different needs, including the requirements of the teaching institutions for experienced instructors, could be satisfactorily met. In suggesting this, we have taken into account the periodical demand made on Indian engineers by other countries in this region. Since our engineers are required by these countries mostly on a deputation basis for short periods, provision for meeting this demand can best be made by including an allowance for this purpose in the Central cadre.

58. Sustained effort at promotion of advanced work and research in the universities is another way of improving teaching standards. It has been stated that in the U. S. S. R., no professor can occupy the Chair of a Faculty if he did not have outstanding research work to his credit and that his continuance in the Chair entirely depends upon sustained research work carried out by the occupant. Experience in other western countries is similar. We feel that one effective way of advancing research in our universities would be to ensure that promotions within the teaching line are made largely on the basis of research work carried out by the teachers. Another suggestion which we would like to make is that serving engineers who display a special aptitude and potentiality for research should be spared for entering such work and paid adequately so that they will not be at a disadvantage compared to their colleagues in the executive line. We have to develop a sizeable group of research workers if we are to keep pace with industrial and technological progress in other countries. Since some time will necessarily elapse before this work yields results, these suggestions will have to be considered with a sense of urgency.

59. The practice obtaining in certain other countries of university staff acting as consultants to Government departments and industry is worthy of emulation, because it would provide the university staff with practical experience. Besides, consultation work might also lead to a greater liaison between the university staff on the one hand and government departments and industry on the other and thus help in the placement of university graduates in suitable positions.

60. While practical experience under actual conditions can be acquired by students only if suitable facilities are thrown open to them in projects and factories, various suggestions have been put forth before the committee to improve the scope and utility of the training which students are asked to undergo within their period of stay at college. One of these relates to the organisation of project work in such a manner that each student will be able to acquire skill in his particular branch of engineering, while at the same time contributing to developmental works like the building of houses and canals, extension of power lines and setting up of small workshops. We feel that this is a line of action which depends for its success largely upon local conditions and as such, no uniform recommendation can be made. It has also been suggested that an appeal should be made for the grant or loan of equipment lying idle in establishments, whether under public or private control, so that it could be distributed between engineering colleges which are at times inadequately equipped. The total volume of

equipment lying idle in this manner is not considerable. We also appreciate that equipment required by the colleges is of instructional type which can generally be obtained only by direct purchase, yet, some useful items may be available in the surpluses with the Directorate General of Supplies and Disposals which should be made best use of.

61. The present method of examination which lays stress on the student's performance in the final test also requires, in our opinion, a partial change in favour of a more scientific system which will give evidence of the professional attainments of a student rather than his power to memorise notes and formulae. Credits should be given for sessional work and tutorials. This system of individual credits, which in its present scope is confined to practical work in the workshops and the laboratories, should be extended to the day-to-day study of theory as well. The suggestion would require for its effective implementation, an increased staff strength which will be more than justified by the improvement in standards resulting thereby.

62. The Committee also recommend that the students who top the lists in the examinations should be guaranteed employment as an incentive for them to do their best. In fact, such a practice had existed in the past in some States. The reluctance of the Service Commissions to accept the procedure seems to have led to its abolition. The Committee recommend its revival, if necessary, by arrangements with the State Service Commissions, since it might help to raise performance standards.



CHAPTER VI

SUPPLY IN RELATION TO DEMAND

63. A comparison of the year-wise estimates of supply and demand (Tables XXIII & XXIV) reveals deficits both at the degree and the diploma levels in almost all categories throughout the second plan period. This situation would warrant the establishment of new engineering colleges and technical institutions in addition to those at present proposed to be opened during the second plan. Since the products from the new institutions recommended by us will be available three or four years hence, in estimating the extent of additional facilities required to be created, we had to ignore the excess of demand over supply in the early years of the second plan and base our recommendations upon the deficits likely to arise in 1959-60 and 1960-61. We have proceeded on the assumption that the entire shortage of degree holders and 60 per cent in the case of diploma holders would have to be met by organising additional training facilities. We feel that the remaining deficit of diploma holders could be covered by organising training facilities on a functional basis and by other arrangements. Before discussing the details of these arrangements, it is necessary to examine the evidence which has been brought to our notice regarding the present unemployment among engineering personnel.

64. The figures of engineers on the live register of the employment exchanges are at times quoted in support of the contention that there is some measure of unemployment prevailing among engineers. A special survey recently undertaken by the Directorate General of Resettlement and Employment to probe further into these figures revealed that 49 per cent of the engineers who registered with the exchanges were employed full-time in engineering occupations; they sought assistance of the exchanges to improve their prospects. The survey further revealed that freshers who graduate from the training institutions are also responsible for swelling the numbers on the register. In our view, the magnitude of unemployment as shown by the registers is overstated. The actual unemployment among engineers is much smaller and is explained by what is known as frictional unemployment for which a small allowance is usually permissible. Considering the fact that the total pool of working engineers in the country consists of about 22,000 degree holders and 29,000 diploma holders, we feel that the unemployment among engineers in the country is not significant.

65. It often happens that when a few vacancies for first-class engineering jobs are advertised, a disproportionately large number of applications sometimes running into thousands, are received and this is hastily interpreted by some as being due to unemployment among the engineers. An analysis of such applications in cases brought to our notice has shown that nearly 95 per cent of these applicants are, in fact, employed and are only taking a chance to see if they cannot secure more coveted posts. This tendency is universal and is not confined only to engineering and technical posts. As such, we feel that isolated rush of applicants for prize posts need not be construed as a worsening of employment prospects for engineers.

66. An evidence that there is not a sufficient supply of engineers, can be had from the Government's experience in promoting apprenticeship training. It has been reported that the scheme, though welcomed by industry, did not evoke sufficient response from graduate engineers. Persons who joined as apprentices left their employers before their training period was over, since they secured firm employment openings elsewhere. While this by itself cannot be considered as a proof of shortage of supply, it

confirms the view expressed in the earlier paragraphs regarding unemployment among engineers. Indeed, an engineer may remain unemployed even as a result of temporary imbalance between supply and demand in certain regions.

67. A further analysis of employment exchange data shows that very few engineers with more than one year's standing are found on the registers. Lack of experience, therefore, is the main cause of their unemployment. We appreciate hesitation on the part of employing agencies to take up persons who, according to them, are not adequately experienced for the job. Such recruitment will only result in sub-standard work and perhaps, increased supervision and costs. While this is true, we feel that too much stress on experience as a pre-requisite for employment is unfair to engineering personnel coming out of technical institutions. We shall be moving in a vicious circle, if for want of engineers our work suffers and for want of employment engineers do not gather the necessary experience. In the circumstances, we feel that the only possible solution to the problem would be for the employing authorities to provide the opportunities for experience to persons who have potentialities of being 'built up'. The employing authorities as well as persons seeking employment should look upon the institutional training as one which develops in the trainee a general background for the work which he is expected to do.

68. We recommend in this connection the procedure followed in the U. S. S. R., where it is reported that even before the construction of a new factory, requirements for technical personnel at different levels are carefully assessed and recruitment made out of students from training institutions. The recruits are then sent to industrial undertakings in the country similar to the one proposed to be set up and trained on the job with the result that when the factory is built and machinery installed, no time is lost in manning it by persons with requisite skills. We note, in this connection, that some of the employing Ministries have already started following this procedure of selecting personnel well in advance of their needs and giving them training in the type of work which they would be expected to do after the period stipulated for gaining experience. We recommend that such arrangements should be made more common.

69. As against the arguments advanced by some that there is an over-supply of engineers, in the evidence before us, a view was expressed that there can never be an over-production of engineers. According to this view, an unemployed technician does not sit idle and will use his skill in some constructive work for the country. Though recent experience in industrially advanced countries lends support to the view that a country can never be saturated with technical personnel, a planned economy envisages that possibilities of both shortages and over-supplies require to be guarded against. Moreover, in a survey recently under-taken, unemployed engineers when questioned as to why they were not utilising their training in the manner suggested above, pointed out to financial difficulties in setting up individuals enterprises. In a country which is in short supply of finance over-expansion of any activity is likely to thwart progress elsewhere and can only be construed, to some extent, as a negation of planning. We, therefore, feel that the facilities contemplated for engineering education must have a relationship with the prospective utilisation of the trainees.

70. Our analysis shows that in the year 1960-61, we will be in short supply of engineering personnel to the extent of about 1,800 graduates and 8,000 diploma holders in different branches. As already stated, we have proceeded on the basis that the entire deficit (1,800) in the case of graduate

engineers and 60 percent (4,800) in the case of diploma holders will be met by organisation of additional training facilities. Further, we have allowed a safe margin and actually planned for an additional output of about 2,300 graduates and 6,000 diploma holders (Vide Table XXV). We have now to find out ways and means of how training for this number should be organised.

71. Obviously it would be quicker to expand facilities in existing training institutions than to set up new ones. There is, however, a limit to such expansion consistent with maintenance of standards. The Committee feel that if existing established institutions are expanded fully, it may be possible to secure on an average a 20 per cent increase in the out-turn of graduates and a 25 per cent increase in the case of diploma holders. Such expansion will also introduce a certain degree of flexibility in the organisation of additional training facilities. This flexibility is necessary, since the demand for engineering personnel in future five year plans, though it will continue to be at a high level, is difficult of quantitative assessment at present. Expansion of capacity in the existing institutions has the advantage that in case the demand for personnel slackened (which we do not envisage), supply could be adjusted by restoring admissions to their pre-expansion size.

72. The proposed expansion in existing institutions will however, cover only a part of our additional requirements. For the remaining, new institutions will have to be opened in addition to those already planned. The All India Council for Technical Education will be in best position to advise on the appropriate expansion in the existing institutions and also for locating the new institutions. The Committee would, however, suggest that in making its recommendations, the All India Council for Technical Education may take into account the considerations advanced in the following paragraphs.

73. We have pointed out earlier the lack of regional balance in supply and demand for personnel. In recommending the setting up of new institutions, therefore, an attempt has been made to distribute them in the four regions of the All India Council for Technical Education, according to the level of excess demand that is likely to arise in these regions. The distribution as proposed by us is indicated in the following statement.

Statement.

NORTHERN REGION (Punjab, Uttar Pradesh, Rajasthan, Jammu & Kashmir, P.E.P.S.U., Delhi, Ajmer, and Himachal Pradesh)

Type and No. of institutions		Capacity per institution					Total additional capacity				
		*C	M	E	T	Total	C	M	E	T	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	
<u>Colleges</u>											
2	50	20	25	25	120	100	40	50	50		240
2	100	—	—	—	100	200	—	—	—		200
4						300	40	50	50		440
<u>Diploma Institutions,</u>											
12	45	30	30	—	105	540	360	360	—		1,260
5	—	50	50	—	100	—	250	250	—		500
17						540	610	610	—		1,760

WESTERN REGION : (Bombay, Madhya Pradesh, Madhya Bharat Kutch Bhopal and Vindhya Pradesh)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	
<u>Colleges</u>											
3	50	25	20	—	95	150	75	60	—		285
2	50	25	20	20	115	100	50	40	40		230
5						250	125	100	40		515
<u>Diploma Institutions</u>											
6	100	—	—	—	100	600	—	—	—		600
5	50	35	20	—	105	250	175	100	—		525
11						850	175	100	—		1125

* C=Civil M=Mechanical E=Electrical T=Tele-communication

EASTERN REGION : (Assam, West Bengal, Bihar, Orissa, Manipur and Tripura)

*C	M	E	T	Total	C	M	E	T	Total	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
<u>Colleges</u>										
8	50	25	25	20	120	400	200	200	160	960
<u>Diploma Institutions</u>										
5	100	—	—	—	100	500	—	—	—	500
24	45	35	20	—	100	1,080	840	480	—	2,400
29						1,580	840	480	—	2,900

SOUTHERN REGION : (Madras, Andhra, Mysore, Travancore-Cochin Hyderabad and Coorg)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
<u>Colleges</u>										
1	30	30	40	30	130	30	30	40	30	120
<u>Diploma Institutions.</u>										
3	—	30	50	—	80	—	90	150	—	240
2	—	30	50	20	100	—	60	100	40	200
5							150	250	40	440

The implementation of these proposals involves the opening of 18 new colleges with a total in-take capacity of 2,045 students (Civil 980 Mechanical 395, Electrical 390 and Tele - communication 280) and 62 new diploma institutions with a total in-take capacity of 6,225 (Civil 2970, Mechanical 1,775, Electrical 1,440 and Tele-communication 40). It is estimated that the total cost of setting up these training facilities (establishment of new institutions *plus* expansion of capacity in existing institutions) will be in the neighbourhood of Rs.16 crores.

74. It will be noticed that the number of new institutions recommended for diploma holders far exceeds the number proposed for training graduates, because over a period sufficient importance has not been given to this aspect of training. The ratio of graduates to diploma holders obtaining in this country is about 1 : 1.3. Evidence collected by the Committee suggests that this ratio should be at least in the neighbourhood of 1 : 3. To fill up the gap, therefore, special efforts require to be made. One of the associations of employers reported to us that its members would prefer

*C=Civil M=Mechanical E=Electrical T=Tele-communication

training their own supervisory personnel and that the shortage at the supervisory levels would perhaps be somewhat lower than is indicated by the ratio arrived at by the statistics of the output of training institutions alone. Allowing for a part of the shortage to be filled by the methods suggested by the association, we still feel that greater attention has to be paid for securing a larger number of diploma holders. The implementation of our recommendations will improve the ratio of graduates to diploma holders to 1 : 2.

75. The statement of demands as phrased by us shows that in earlier years the requirements for engineering graduates and diploma holders exceeds supply. Interim arrangements will, therefore, have to be made to fill this gap. We recommend the adoption of a series of temporary measures such as promotion from lower ranks, a more balanced utilisation of available talent, the retention of persons for suitable periods beyond the age of superannuation and even temporary overloading, to some extent, of existing engineering personnel, wherever it is not already being practised.

76. To a certain extent, shortages at different levels could be met by effecting promotions from lower ranks. Engineering graduates, who under current practice have often to spend some time in subordinate positions should be promoted to higher ranks where their services can be utilised in a fuller measure. In making this recommendation, we are aware of the fact that some of the lower posts involve duties which only graduate engineers can satisfactorily undertake. This limitation has to be kept in mind while promoting graduates. Diploma holders who have manifested their ability to assume higher responsibilities should also be considered for executive posts. Quick and wholesale promotions as a method of overcoming shortages however, is not desirable as a long term policy.

77. As a further step towards meeting shortages, we feel that a systematic survey should be conducted by employers, particularly in the public sector, with a view to assuring that all employees with engineering experience are fully engaged in activities which make for maximum utilisation of their talent. Economy can be achieved in the use of personnel resources by undertaking such a job analysis and on its basis dividing job functions and allocating only the more complicated operations to qualified personnel. The essence of planning is to avoid overemployment or under-utilisation. We note that experiments made in certain departments of Government towards effecting economy in the use of technical personnel are showing encouraging results, but these experiments should be watched further before steps are taken to effect personnel economy and using non-engineering personnel for functions for which ordinary science graduates will be adequate.

78. Attempts have been made in recent years by the Central and State Governments to utilise the services of retiring and retired men by extending the term of service in the case of the former and by re-employing the latter. These measures have been adopted both for making up shortages and for filling up posts where considerable experience was required. The steps taken have not been completely successful and certain difficulties have been brought to light. It is reported that where extensions of retirement age were granted on a year to year basis, persons so engaged felt a sense of uncertainty; such extensions were also found to be administratively cumbersome. Though the policy pursued by States in this respect does not seem to be uniform, at the Centre extensions of service are freely granted in regard to technical personnel. Even the prior approval of the Ministry of Home Affairs has been dispensed with. In case of re-employment, there are difficulties in fixation of pay. Retired officers are paid the minimum of the revised scale which is usually less than the salary they drew at the time of retirement. They, therefore, preferred extension of

their service where their salary at the time of retirement was secured. Though Government would consider re-employment more desirable to avoid difficulties with the regular cadre, in view of the large expansions contemplated, even extension of service should not be ruled out. The Committee recommend that some uniform procedure should be laid down by States and Central Ministries whereby engineers will be retained beyond the age of superannuation subject to their being found medically fit. This policy requires to be reviewed from time to time, taking into account the availability of personnel and the interests of regular cadres.

79. Although we have suggested temporary over-loading, we feel that while it may help to tide over the period of acute shortages, it cannot obviously be practised as a permanent measure without impairing the health and efficiency of serving engineers.

80. At the higher levels, the interim measures suggested in the preceding paragraphs may be just about sufficient to cover deficits during the first four years. At the supervisory level, however, these steps will have to be supplemented in a large measure by organising functional training in view of the physical limits to the expansion of institutional training facilities. Functional training will have to be continued even after the interim period, since the new facilities recommended by the Committee for diploma courses are intended to meet only 60 per cent of the deficit in 1960-61. In making this recommendation, we have been guided by the consideration that organisation of functional training might, by supplying supporting staff, reduce the requirements for personnel with comprehensive engineering education. How far our assumption is correct can only be seen by experience over a period of years, though limited experiments on these lines in the River Valley Projects, the Survey of India and in some of the States have yielded good results.

81. Our recommendation also takes into account the possibility that standards may be lowered by compressing too much expansion in regular institutional training facilities in a short space of time. A view has been expressed that even at the cost of a slight deterioration in quality, the training of technical personnel should be rapidly accelerated. We feel, however, that quality should not be sacrificed to quantity. By splitting the job operations and training men for limited purposes, a large number can be trained in short periods without sacrificing quality. For this purpose, we recommend that the training should be imparted in integrated courses of theoretical instruction and practical work, the major part of the time being spent on the job. The duration of the courses will naturally vary with the specific duties to be performed. The staff of the engineering colleges or technical schools in the vicinity of the training centres may be drawn upon on a part-time basis for providing theoretical instruction to the trainees.

82. One of the engineering associations with whom we had discussions welcomed this suggestion and were prepared to spare even some of their higher technical staff for imparting training and to provide the necessary facilities by way of equipment, places for training and so on. For practical instruction, they were hopeful of persuading the members of their association to make suitable arrangements. The Institution of Engineers (India), in their evidence before us, also were of the view that such training would help in over-coming the existing shortages. The Institution, which has branches all over the country, were willing to offer all the cooperation that such a scheme required if our recommendations were accepted for implementation. We feel that such offers should be fully utilised.

83. The measures discussed so far relate to physical shortages in the availability of personnel. Not infrequently, however, shortages arise out of organisational and administrative difficulties. Rigidity in financial rules and procedure is also known to stand in the way of a rational personnel policy. It has been brought to our notice that in some States, it is the practice of Government to get posts sanctioned only after existing men had overworked and shortage of staff had been proved. In other words, recruitment in anticipation of needs is not permitted. It is unnecessary to point out how such a procedure may not be appropriate in the context of planned development, when post recruitment training in anticipation of needs is essential. It is also stated that direct recruitment for temporary posts is not favoured by Government and departmental promotion has to be invariably resorted to in all such cases. A number of vacancies have been filled on this basis and the results are not very satisfactory. Here, again the financial rules have to be adjusted to conform to the realities of the situation. Direct recruitment should not be disallowed to posts which though classified as temporary, are likely to continue for a long time. During the course of our discussions with State Governments, it was pointed out that objection was raised by the Audit to the appointment of persons not satisfying the qualifications prescribed for particular posts. If, for example, a person was a certificate holder and was appointed to an overseer's post, instead of being appointed as a sub-overseer, which was his entitlement, the Audit would object to paying him the scale of overseers, however experienced the person concerned might have been. We consider that the qualifications prescribed for recruitment should be made more flexible to permit the absorption of personnel who may otherwise be found suitable.

CHAPTER VII

SKILLED WORKERS

84. We have examined the data sent to us by different Ministries and State Governments regarding their requirements for skilled workers. This examination only strengthens our fears about the difficulties of assessing the demand and supply of personnel in lower categories. The types of craftsmen in the field of engineering are so many and requirements of different undertakings so varied that it almost becomes impossible to secure reliable data. There is, again, inadequate coverage in the sense that employing authorities have neither indicated the main categories of their demands exhaustively nor assessed adequately the numbers required even under the categories chosen.

85. Difficulties in the assessment of supply are equally great. There are various methods by which artisans and craftsmen are trained. While institutional training meets the demand for skilled workers to a considerable extent, another source of supply consists of persons who join as unskilled workers and acquire skills in the course of their work. Again, there are some craftsmen who, as already stated, learn skills imparted in the family, from father to son, brother to brother and so on. Surveying the training facilities so provided, is impossible.

86. It is not as if these difficulties are peculiar to Indian conditions. Even in the United States where considerable work in this field has been going on for some time and where the statistical organisation has been far more adequately built up, difficulties of assessment become evident when one attempts to forecast demands at lower levels. In the United Kingdom also, which is much better served with personnel statistics than we are, it would appear from a recent White Paper on Technical Education that the assessment of training facilities required for lower levels has been found impossible. To quote "Even within this country there is such a wide range of technical qualification that there is ample room for argument about which qualification should be included in which category. Moreover, many craftsmen and some technicians, are trained solely on the job and do not figure in any statistical returns". The position in regard to other countries with highly developed statistical organisations is in no way different.

87. In the circumstances, all that we can attempt and have attempted is to indicate on the basis of the experience of persons who gave evidence before us, the categories in which shortages are likely to occur in different regions. The statement below indicates the trades for which, in different regions, special efforts will have to be made in coming years to augment supplies.

<u>CATEGORY</u>	<u>REGIONS WHERE SHORTAGES ARE ANTICIPATED</u>
Cable Jointers	All regions
Electricians	Eastern
Linesmen	Eastern, Western and Northern
Machinists	All regions
Mechanics	Western and Southern
Moulders	Eastern and Western
Pattern Makers (Metal)	Eastern and Western
Pattern Makers (Wood)	Eastern and Western
Riveters	Eastern, Western and Southern
Tool Makers	All regions, specially Western
Welders	All regions

88. For all these trades, lack of mobility is major factor to be taken into account in making arrangements for training. Even the mobility within a region which has been assumed for purposes of our assessment of higher engineering talent may not be safe in the case of craftsmen. That is why over-all shortages in certain trades exist alongside of surpluses in those very trades in specific areas, mainly arising on completion of projects. It is not possible to solve this problem all at once. Incentives like provision of houses and other amenities for encouraging mobility among skilled workers will have to be steadily built up. The deployment machinery which we have elsewhere proposed for adjusting shortages and surpluses of personnel between projects will also have a contribution to make towards improving the situation in this regard. While these remedies are being undertaken, it is necessary to see that new projects do not suffer for want of personnel at the lower levels.

89. It is not possible to venture a guess at this stage, as to the extent of additional training facilities which will be required for different types of craftsmen. We note, however that the Ministry of Labour in the Directorate General of Resttlement and Employment and the States have devoted considerable attention to training of craftsmen and have included schemes in the second plan for expansion of these facilities. We recommend that the new institutions should be built, as far as possible, around factories and projects. So that not only can the men be trained in proper environment, but their absorption in suitable employment can also be facilitated. We recommend that the employing authorities should take full advantage of the basic training given in such institutions before they tap other sources. Considerable advantage is likely to be gained if the institutional training at present available and to be created is geared to the requirements of employing authorities by frequent consultations between the training institutions and the employers.

90. In the course of our discussions with contracting firms and some firms requiring skilled craftsmen, there was a uniform praise for the capacity of our workmen to adapt themselves to new skills, especially when these were imparted through a medium of instruction understood by them. It was revealed to us that an educated person of today was willing to take up manual work; an artisan of today was a better trained person than the artisan in the past. After all, craftsmen in all countries have been the products of circumstances. It is reported that in the United States, during the Second World War, even the work of intricate rivetting for air-craft production was handled by women "Rosy Rivetters" with comparatively short periods of training. In this country also, in the same period, workers engaged in wagon repair shops were made to change over to the art of aeroplane repairs after suitable in-plant training. As another instance of complete novices being trained in efficient handling of heavy machinery, we would like to cite the experience of the Gangapur project in Bombay State. We feel confident, therefore, that despite the insufficiency of information on the numerical aspect of the problem, there are indications that given the right atmosphere, engineering activities will not suffer for want of craftsmen.

CHAPTER VIII

APPRENTICESHIP TRAINING

91. In discussing the need to break the vicious circle where industry with its demand for personnel and freshers from colleges in search of opportunities to show their worth chased each other, we pointed out that employers should accept available personnel and train them further to suit their requirements. While this is the only method in which the requirements of employers could be met in the immediate future, a continuance of the present state of affairs can be avoided only if industrial establishments trained personnel in advance to meet not only their individual needs, but also the expanding requirements of the country. Our discussions with employers' associations revealed that they are willing to cooperate in this respect; in fact, some firms have already started running apprenticeship schemes to meet requirements in addition to their own. One of the associations, while discussing this problem with us, indicated that it had recommended to its member organisations that they should expand training facilities on a scale which would allow for possible losses by way of 'flight'. There are, however, certain difficulties in promoting apprenticeship schemes on a wide scale and these require to be tackled.

92. Due to historical circumstances of delay in the development of mechanical industries, the opportunities for apprenticeship open to graduates in these fields have remained inadequate. They are likely to expand with the growth of machine building and fabrication industries. In the immediate context of expanding steel production, however, special efforts will have to be made for augmenting the placement of apprentices in existing establishments themselves, if the increased steel production has to find its uses.

93. One of the difficulties advanced before us by employers who were anxious to promote expansion of the machine building and fabricating industries, was the lack of phased orders. They urged that if Government assessed its future requirements well in advance and placed orders which would, for their execution, need personnel lasting over a sufficiently long period, the planning of training programmes in the firms would be considerably facilitated. According to them, they were asked to organise production at short notice and if firms found it impossible in the circumstances to accept such orders, import licensing was resorted to even for articles for which the production capacity in the country had been proved. The Engineering Capacity Survey Committee, which examined the position in this regard has expressed similar views in its report. We recommend that this difficulty in expanding our engineering production should be removed both in the interest of stepping up internal production and for widening the scope of apprenticeship in engineering trades within the country.

94. Arrangements for training Indian personnel are not uniform. It is our view that whenever such consultants are engaged to set up a plant, there should be a condition that they will train technicians to meet not only the needs of that single plant, but also those of similar plants, programmes for establishment of which are in sight. We were told by the associations that in a recent operation of laying pipe-lines below the sea, carried out by collaboration with a foreign firm our engineers were able to learn the job thoroughly and that for any similar work in future, no foreign help need to be sought. It was also pointed out to us that this practice was not uniform and that there were occasions where Indian engineers were not given facilities for entering big engineering works in partnership with foreigners. In this connection, we would like to emphasise that no opportunity which is likely to add to the technical wealth of the country should be missed. We would

further suggest that when orders for equipment are placed with foreign firms, the suppliers of machinery should be asked to offer facilities to Indian engineers to acquire experience in their works abroad. To some extent this practice is current. We consider it appropriate, however, to mention it again since this is an important source of providing practical training for our engineering personnel.

95. The main difficulty pointed out by employers in promoting apprenticeship is the cost of such training, which the employers fear they may be asked to shoulder. Different committees which have discussed this question have expressed the view that legislation may be necessary to promote the placing of apprentices. In some countries, a cess is levied on industrial employers by government for this purpose and a rebate is allowed to the extent that employers arrange their own training programmes. Such rebates are known to have stimulated organisation of training by employers themselves. A plea was made before us by employers that Government should subsidise apprenticeship training. There are schemes for apprenticeship to which a reference has been made earlier in the Report. We feel that in view of the awareness of employers to train apprentices in addition to their requirements, voluntary efforts, supported by Government, will meet the needs of the situation. If, however, sufficient progress is not in evidence in the next two years, suggestions regarding legislation or levy of a cess may have to be considered.

96. Accommodation presents another difficulty in organising apprenticeship training. Living space is found to be scarce in cities like Calcutta and Bombay where even existing facilities cannot be availed of on this account. It is, therefore, necessary to take up urgently the question of building hostels to get over the difficulty.

97. Employers are also often hesitant to accept schemes for apprenticeship training, because of difficulties which they think they might experience with labour. It has been stated that workers who are helped by apprentices during their training period, begin to view this help as a matter of right and express dissatisfaction when it is discontinued, i.e., when the apprentices leave after completion of training. We feel that this situation possibly results from some of the employers treating their apprentices as workers rather than as trainees. Such practice should be discouraged. Apart from this, under an established and continuing scheme of apprenticeship training as envisaged by us, one batch of trainees will be replaced by the next batch and workers will have no cause to be dissatisfied. Further, with the growing awareness on the part of workers of the fact that the ultimate benefits of training schemes will be shared by all concerned including themselves, we feel that increased co-operation from them will be forthcoming. We feel that as in other countries, our trade unions will play an important role in advancing this awareness.

CHAPTER IX

FLIGHT OF PERSONNEL

98. When demand for personnel exceeds supply, competition sets in among prospective employers to secure the services of available men who tend to move from job to job at a rate that some times hampers the execution of projects. Under normal conditions, a degree of mobility is tolerable and perhaps, even desirable, but unplanned movement of personnel from project to project while the works are under execution is detrimental to maintaining progress according to schedule. Moreover, temporary personnel in whatever capacity they may be employed, are always pre-occupied with their future and are unable to give their best to employers. Also, the expenditure on staff increases because the employers who outbid one another in securing such personnel have to pay them heavily.

99. In recent years, the "flight of personnel" among engineers is reported to have assumed disconcerting proportions. In one State, nearly fifty percent of the engineers recruited in a year had resigned for improving their prospects. Similar situations arose earlier in some of the Central Ministries. Employers' associations and contracting firms also held the view that turnover of engineering personnel had lately increased. There is competition for technical personnel between the public and private sectors; between universities and industry; between States and the Centre and within these individual groups themselves. The sufferers in the bargain are universities, local bodies and smaller industries which cannot compete effectively in this race.

100. The problem is not peculiar to India. It has been noticed in other countries; in times of international shortages, the 'flight' of personnel cuts across even the national barriers. While in recent years, the United Kingdom, the United States and Canada have all been experiencing shortages of engineers, American employers have been able to draw away a large number of engineers from Britain. In 1952 alone, over 1,300 of the permanent emigrant from Britain are reported to have given their occupation as "professional engineer".

101. Though 'flight' of personnel assumes serious proportions under conditions of shortages, we feel that the difficulty is essentially one of organisation and does not substantially affect our over-all requirements in terms of numbers. Job shifting is tied up more with differences in salary scales, security of tenure and regional preferences than with shortages. These are important questions and the success of our personnel policy in relation to engineers will depend as much on their solution as on the expansion of training facilities.

102. It may not be possible to regulate salary scales in the private sector, except to the extent the type of society we propose to fashion permits. We do not, however, consider the competition of the private sector as of much consequence, except perhaps in some isolated fields. It would thus be enough if the scales of pay between the Centre and the States are broadly the same. With the large scale development in the public sector, it may be necessary to bring salary scales in the public corporations also in conformity with those of the Central and State Governments. Unless such a balance is brought about by conscious effort, certain projects whose authorities are willing to offer high salaries will drain the best engineering talent to the disadvantage of other equally important needs. Though we recognise that the finances of certain States do not permit them to employ engineers on the scales of pay obtaining in more prosperous States, it would still be desirable for them to agree to a common line of action which would have to include within its scope the evolution of uniform conditions of service for persons engaged

on development schemes. To compensate for the unattractiveness of temporary posts, the pay scales should be better than those applicable to members of regular establishments. Appropriate allowances should also be framed containing elements for cost of living in different regions and for out-of-state service. A suitable system of unemployment benefits should be worked out for those who are intermittently out of employment.

103. While steps are being taken to augment the total pool of engineering personnel in the country, we feel that nothing should be done to impair the morale of serving engineers, who in many instances have to carry on in a temporary capacity for long periods, sometimes extending to fifteen or twenty years. It has been brought to the notice of the committee that there have been instances where engineers who faced no prospect of confirmation even after putting in long years of service, had been prevented from applying for permanent posts in Government advertised by the Public Service Commissions. Since the retention of engineers who are engaged on work of national importance is absolutely essential, steps should also be simultaneously taken to guard their long term interests. One line of action would be to reserve a portion of the permanent vacancies for those who have done good work in temporary assignments on the analogy of war-time experience, when a certain number of civil posts were reserved for candidates who had rendered approved war service. In the mean time, we recommend that whenever an engineer is offered a fresh temporary appointment, periods of service already put in by him in comparable positions elsewhere should be given credit in fixing his starting salary and seniority.

104. Recommendations contained in this chapter would require for their full implementation the setting up of some authority by agreement between the States and the Centre for (a) regulation of salary scales and security of tenure and (b) allocation, inter-state movement and welfare of personnel engaged on development projects outside the regular cadres. Machinery that we envisage for this purpose is discussed in a later chapter.

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CHAPTER X

RECRUITMENT POLICY

105. Delay in obtaining equipment through the Directorate General of Supplies and Disposals and in recruiting personnel through the Union Public Service Commission were some of the reasons advanced before us by Ministries, as having impeded the progress of development in the first plan. While the former does not fall within our terms of reference, we have to take note of the latter. In the context of shortages of engineers, representatives of Ministries urged before us that the present recruitment procedure which takes the Union Public Service Commission about 8 to 10 months to supply candidates, was too rigid. When many projects basic to our development have to be executed according to a strict time schedule, we recognise the necessity of a flexible recruitment procedure. We have, therefore, to find out ways to secure this flexibility consistent with the requirements of the Constitution. In the following paragraphs though we have made suggestions specifically with reference to the Union Public Service Commission, we consider that they are applicable *mutatis mutandis* to the State Public Service Commissions as well.

106. We realise that the Commission cannot ignore the constitutional requirements of ensuring equality of opportunity. Vacancies have to be advertised all over the country and reasonable time allowed for receipt and scrutiny of applications and for the candidate's journeys to attend interviews. There is no doubt, however, that a good deal of delay which now takes place is due to the fact that the Commission has been functioning at below the sanctioned strength of members for a considerable time and arrears of work have piled up. We would, nevertheless, deprecate any suggestion that because recruitment through the Commission now takes too long, such recruitment should be taken out of its purview altogether. We would rather that the employing authorities plan their recruitment for development programme well in advance as they do in case of their normal needs, taking for granted some delays in the Union Public Service Commission. There are obvious advantages in an independent body like the Commission being associated with recruitment and solution for speeding up the process should be sought through (a) suitably strengthening the Commission, (b) bifurcating its work relating to senior and junior posts and (c) devising simpler and quicker methods of consultation.

107. The introduction of the new procedure, by which a discussion between the Commission and Ministries' representatives preceded written references, has to some extent avoided delays in recruitment. In some cases where advertisement proved ineffective in securing suitable candidates, the Commission permitted the Ministries to present for interview persons spotted cut by them. Short cuts have been adopted in the case of recruitment of flood control personnel under the Ministry of Irrigation and Power and personnel for the departmentally managed projects under the Ministries of Iron & Steel and Production. These are indications of the appreciation on the part of the Commission to the urgent recruitment needs in connection with the implementation of the five year plans.

108. Eight to ten months may not be a long period in normal times for routine recruitment of annual replacement needs which can be forecast well in advance. Under present conditions, however, there are bound to be instances where posts have to be filled at short notice. In such cases, it is not only the applicant who suffers from delayed recruitment, but also the employer.

Instances are not wanting where, because of delay in receiving a call from the Union Public Service Commission, candidates successfully competed for other jobs and were lost for Government appointment and the Commission, in turn, found it difficult to recommend candidates. This is a case of "recruitment delayed is recruitment denied".

109. Under present arrangements, engineering graduates have necessarily to waste about a year if they want to be selected through the Union Public Service Commission. We feel that this is unnecessary and should be avoided. In countries like the United Kingdom, the United States and the U.S.S.R., it is reported that three to four months prior to the final examination prospective employers go round the engineering colleges and interview students with offers for appointment on successful completion of the university examination. Obviously, adoption of such a system would become prevalent in this country when the demand for personnel far outstrips supply. On the present analysis of our requirements, though this stage does not seem to have been reached, the procedure of recruitment to services at the college campus is worth giving a trial more because of (a) the advantage of speeding up recruitment and (b) the beneficial effect which a Service Commission going round the universities will have on students.

110. Another suggestion which we would like to make for speeding up recruitment is that there should be one or two bulk selections every year for technical men of a particular category. It should be made known, for instance, that by a certain date, say within two months of the declaration of university results each year, all those who have prescribed basic qualifications and who want to be considered for selection should apply to the Union Public Service Commission without waiting for an advertisement. Interviews for selection on the basis of such applications should be held within two months of the receipt of applications. The advantage of this procedure would be to cut short the time between the departmental requisition to the Union Public Service Commission and the date fixed by the Commission for receiving applications. This method has been tried successfully in the case of officers in the Survey of India. For implementing this suggestion, it is imperative that the requirements of departments for different categories of personnel should be assessed well in advance and lumped together. Names of candidates who are found fit, but are surplus to requirements may be put on a roster from which subsequent vacancies can be filled without further reference to the Union Public Service Commission.

111. The creation and maintenance of a Register of Technical Manpower is another important step which, in our opinion, is long overdue. As early as 1949, the Scientific Manpower Committee recommended the compilation of a National Register of Scientific and Technical personnel. This work was entrusted by the Cabinet to the Council of Scientific and Industrial Research, but even after six years, it cannot be said that the Register is in a condition where it can be directly useful. We recognise the difficulties in the matter. At the same time, in view of the importance of the scheme and its immediate utility in the context of the large anticipated demand on qualified technical personnel, we feel that priority should be given to the systematic compilation of the National Register. Professional bodies like Institution of Engineers (India), the National Institute of Sciences etc., would be only too willing to cooperate. The object should be to maintain an up-to-date card index of technically qualified persons of different categories and sub-categories showing their qualifications and experience. We feel that the Union and State Public Service Commissions will take advantage of the proposed Register in meeting demands for technical manpower. As and when demands for technical manpower arise, it will then be easy for them to sort out persons

where suitability for being interviewed is guaranteed and availability only need be tested. The organisation and methods for the creation and maintenance of such a Register would have to be worked out, but we think the effort and the money spent on it will be worth-while. We understand that the Union Public Service Commission is examining in the context of the second plan how best it could speed up its recruitment procedure. In doing so, we are sure the Commission will take this recommendation into account.

112. A suggestion was made that recruitment through the Union Public Service Commission could be expedited if the preliminaries like advertising posts, initial scrutiny of applications, etc., upto the interviewing of candidates could be entrusted to the employing authorities. While there may be some apparent advantage in such a procedure-employing authorities are bound to expedite the preliminaries when they are badly in need of personnel, - the criticisms to which they lay themselves open far outweigh the advantage that is likely to be gained. If this work is to be done by the employing authorities, they would necessarily have to maintain suitable staff for the purpose. If the same staff is made available to the Union Public Service Commission, advantage of this procedure could be combined with the confidence which the public have in the selections by the Union Public Service Commission.

113. It is not known how far there is an effective machinery for bringing to the notice of our nationals receiving technical training abroad, vacancies which are advertised by Service Commissions and also by private employers. We suggest that these students should register themselves with our Embassies or Consulates and that an attempt should be made to contact them when employment opportunities suitable to their training are advertised in India.

114. We have considered the question of direct recruitment *versus* departmental promotion. In certain Ministries, there appear to be precedents fixing proportions in which fresh vacancies are to be filled by the two methods. We recognise that each method has got its own advantages and drawbacks and that a judicious combination of both as at present exists is commendable. While departmental promotion will bring to executive levels men who know the job, direct recruitment will fetch persons with a breadth of vision so necessary for planning and which might be lacking in departmental candidates. All that we recommend is that departmental promotion should not reach a stage where it results in dilution of cadres.

115. Another point which has been brought to our notice is that the present age composition of the engineering cadres in Government are not properly balanced. Majority of engineers are either fresh recruits or belong to the higher age groups. We feel that future recruitment policy should be adjusted by a careful study of the present age composition of serving engineers in different departments and the need to keep it in balance.

CHAPTER XI

IMPLEMENTATION OF MANPOWER POLICY

116. The successful implementation of a manpower policy implies (a) an effective and continuous collection of the necessary information, (b) the framing of policy on the basis of information so collected and (c) the execution of such policy. Each of these functions requires a suitable organisation.

117. A continuing information programme is necessary, because the personnel situation is essentially dynamic. It may be pertinent to point out that in spite of considerable expansion in technical education in the last fifteen years in the United Kingdom, substantial demands for additional training facilities are experienced for maintaining the increased tempo of development. We do envisage such a situation to arise in India also. While the recommendations made by us in this Report are designed to see us successfully through the second plan and the early years of the third plan, it is not possible at this stage to forecast the requirements beyond that period, except to say that our needs for engineering personnel will be on the increase. It is necessary, therefore, to keep a continuous watch on the supply and demand position so as to be able to embark on expansion of training programmes as soon as indications of additional demand for personnel become sufficiently manifest. Some arrangement exists in the Ministries of Education and Labour and the Planning Commission for the collection and processing of manpower information on the supply and demand sides. With improved coordination among these agencies collection and interpretation of the necessary data on a continuing basis would not be difficult.

118. There is, however, no authority in the country at present to give overall guidance and to effect coordination in policy matters affecting technical personnel. In almost all countries, manpower is considered as the nation's "first resource" and increasing attention is being paid by Government to manpower budgeting. We feel that a beginning should be made in this country at least in respect of budgeting for technical manpower, especially when large sectors of our economy like railways, defence establishments, the Central Public Works Department, multi-purpose projects and the national laboratories require technical personnel of different categories and at different levels. With Government's decision to take over the responsibility of organising major industries such as steel, coal, heavy electrical plant, machine tools, foundry and forge shops etc., requirements of personnel in the public sector would go on increasing. We feel, therefore, that policy in regard to technical manpower should emerge from the Centre and that a suitable organisation should be set up for this purpose.

119. The object that we have in mind could best be served by setting up a Technical Manpower Committee of the Cabinet, because this is a field where policy and coordination affect almost all Ministries and decisions have to be taken at the highest level. The Cabinet Committee should be served by a corresponding Committee of Secretaries. The latter committee will shoulder the executive functions of the Cabinet Committee and should, in turn, be aided by competent staff. For this purpose, we recommend that a Technical Manpower Division be created in the Planning Commission. This Division should be put in charge of a special officer who is made responsible for the collection and processing of the necessary information and for presenting proposals to be considered in the two Committees. It is important that the officer selected for this purpose

must not only be thoroughly conversant with manpower problems, but also be sufficiently resourceful to go and get things done, because the normal inclination to sit back and ask for information is not likely to produce results. One of his main functions will be to keep in constant touch with the Ministries, States and other employing authorities with a view to securing advance information on personnel demands. Equally important will be his responsibility of ensuring, through the Ministry of Education, that training facilities are expanded in good time.

120. The arrangements envisaged in the previous paragraph should be part of a larger set-up for tackling specialised manpower problems. In addition to the Special Officer for technical personnel, there should be two other officers of similar rank and responsibilities and possessing the same drive for executing policies relating to industrial management and general administration cadres. Though these two subjects do not strictly fall within our terms of reference, the lines of demarcation between technical cadres and cadres for administration and industrial management are getting thinner to some extent and requirements for technical manpower are linked with those in the two other fields. The three officers, between themselves, under guidance of the Chairman of the Secretaries' Committee, will be responsible for administering the decisions taken by the two Committees.

121. There ought to be a sense of urgency in the creation of the proposed authority, since judging from past experience, recommendations relating to technical manpower are known to suffer for want of implementation. For instance, the River Valley Projects Technical Personnel Committee recommended that urgent steps should be taken to train a large number of "Technical Assistants" so that they could be in position by March, 1956 for implementing the second plan, but with one or two exceptions, no State is reported to have moved in the matter. Some of the recommendations of other Committees which reported on personnel requirements in the past also suffered the same fate. We feel, therefore, that no time should be lost in setting up the Technical Manpower Committee with the supporting agencies.

122. There will also have to be similar committees at the State level for meeting local needs and one of the functions of the Technical Manpower Committee suggested in the previous paragraphs would be to assist, wherever necessary, the State manpower committees.

123. During our discussions with Ministries and the Chief Engineers in States it was repeatedly mentioned that great difficulty was experienced in securing engineers of high calibre for the various Government departments. For planning and executing the Engineering and Industrial projects which form a major portion of the total outlay in the second five year plan and would have the same importance in a number of plans to come, it is necessary to secure the services of the best engineering talent available in the country. This can be achieved only if adequate incentives in terms of prestige and remuneration are linked with engineering jobs by creating an All India Service of Engineers and training the members of this service on a common basis so that they will have uniform standards of efficiency and, what is more, a unity of purpose. Moreover, the members of an All India Service are more likely to ensure continuity and spread of technical policy and to express more informed technical opinion than would otherwise be available to Government. In this connection, the Ministry of Irrigation and Power have been, for some time past, in correspondence with the State Governments. The question was also discussed recently at a conference of Chief Ministers of State held in October, 1955, but the discussions were necessarily only of a preliminary and

informal nature. It may be recalled that the River Valley Projects Technical Personnel Committee had also suggested the institution of an All India Service of Irrigation and Power Engineers, comparable in all respects with the other services. More recently, this view has found support in the Report of the States Reorganisation Commission. We recommend that in the light of these considerations, the Central Government should explore the possibilities of instituting a suitable All India Service of Engineers by common consent of the participating States.

124. There is one other suggestion which we would like to make in regard to engineering personnel, in particular and technical personnel, in general. The attraction for the Civil Service which once led the cream of the country's youth into arts and law courses is still there in the Indian Administrative Service, though to a diminished extent. In the present context of building up a welfare State, there is greater need for diversification in administration. We recommend that technical and scientific personnel should be introduced at suitable levels in the general administrative machinery, especially to hold posts where their experience is of value.

Y. N. SUKTHANKAR, Chairman.

VISHNU SAHAY, Member.

KANWAR SAIN, do

M. S. THACKER, do

S. B. BAPAT, do

Sd. S. RANGANATHAN, do

K. N. SUBRAMANIAN, do

K. P. MUSHRAN, do

H. P. SINHA, do

G. K. CHANDIRAMANI, do

B. D. KALELKAR, do

N. GOVINDARAJAN, do

H. DAVENPORT, do

B. N. DATAR, Secretary.

New Delhi,

Dated 17th May, 1956.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

1. There has been a considerable expansion in engineering education in the country in recent years. Even so, the demand for engineering personnel has outstripped supply. (16)*

2. A high level of demand is likely to be sustained in view of the future emphasis on development of heavy industries. (17)

3. Advance assessment of needs is necessary not only for supervisory and higher grades of engineering personnel, but also for skilled workers, who constitute a vital component of technical manpower resources. (20)

4. There is a certain amount of immobility among technical personnel, especially at lower levels. In spite of incentives that may be thought of for promoting mobility, resistances are likely to persist. The regional aspect of demand and supply has, therefore, to be kept in mind. (21, 41)

5. In assessing future demand for technical personnel, the following assumptions have been made:—

- (a) No major technological change as would seriously affect the requirements of engineering personnel will take place in the next five years. (22)
- (b) The present pattern of distribution of work between departments and contractors and as between small and big contractors will continue in the second plan also. (23, 24 & 28)
- (c) An increasing proportion of graduate engineers will be employed in the private sector. (33)
- (d) A substantial number of qualified engineers will be required to staff the additional capacity to be created for institutional training. The cadres will be strengthened to allow for a reserve for refresher training and deputation within and outside the country. (34, 57)

6. Central Ministries and State Governments had indicated comparatively heavy demands in the initial years of the second plan. Since these demands cannot be met all at once, they have been re-distributed between different sectors of development and between the five years of the second plan to correspond to a more realistic pattern of demand. This should not be considered as actual allocation of personnel to different regions or ministries. (36)

7. It is necessary to create a suitable deployment machinery to coordinate the release of personnel from one project and their absorption in another. (39)

8. Foreign training for our engineers should be made more purposeful by advance mapping of fields in which such training is urgently required and ear-marking trainees for suitable positions in the country on successful completion of training. A larger proportion of foreign scholarships should be made available to teachers in engineering institutions. (46)

9. Post-graduate training facilities in engineering subjects should be provided on a wider scale within the country. (46)

10. Engineers who have qualified in specialisations for which demand

* Figures in brackets refer to paragraph numbers.

is likely to develop should be afforded facilities for pursuing advanced work in their chosen fields in (a) design and development wings attached to state enterprises and (b) engineering and technological institutions. (47)

11. Since demand for specialists has not developed to any considerable extent, it will be more advantageous to continue the present arrangements under which training is more broad-based. (49)

12. While standards in respect of top students in the engineering institutions have been maintained, there is reason to believe that a certain lowering of average standards has taken place. (51).

13. Reasons for the deterioration in quality are:—

- (a) dearth of teachers of the right calibre,
- (b) inadequate facilities for practical training,
- (c) ineffective methods of examination and enforcement of standards and
- (d) possibly also, insufficiency of equipment in some institutions. (51)

14. Standards in engineering institutions should be improved by: —

- (a) bringing service conditions for teaching staff on par with those obtaining in executive positions under Government. (52, 53)
- (b) sparing competent and experienced men from government cadres for teaching in colleges, (54)
- (c) arranging field experience in industrial enterprises and engineering projects for teachers to help them keep in touch with the progress taking place in current engineering practices, (55)
- (d) promoting advanced work and research in universities, (58)
- (e) making promotions within the teaching line largely on the basis of research work carried out by staff, (58)
- (f) allowing serving engineers who display a special aptitude and potentiality for research to enter such work on adequate remuneration and
- (g) encouraging consulting work by university staff. (59)

15. Standards of examination should be improved by effecting a partial change in favour of a system which will give evidence of the professional attainments of a student rather than his power to memorise. (61)

16. As an incentive for better performance, employment should be guaranteed to students who top the lists in the examinations. (62)

17. There is not sufficient justification for the belief that engineering personnel are surplus to country's requirements. (63 to 67)

18. Lack of experience is the main cause for unemployment among engineers. An engineer may also remain unemployed as a result of temporary imbalance between the supply and demand in certain regions (67, 66)

19. Employing authorities should provide opportunities for experience to persons who have potentialities of being 'built up'. (67)

20. The practice of advance recruitment of technical personnel and their

training prior to posting should be adopted on a wider scale. (68)

21. It is anticipated that in 1960-61, engineering personnel will be in short supply to the extent of about 1,800 graduates and 8,000 diploma holders in different branches. (70)

22. To meet the shortages, capacity in existing established institutions should be expanded fully. It may be possible to secure in this manner an average increase of 20 percent in the out-turn of graduates and 25 per cent in the case of diploma holders. (71)

In addition, 18 colleges and 62 diploma institutions will have to be opened. The total cost of setting up these training facilities (establishment of new institutions and expansion of capacity in existing institutions) will be in the neighbourhood of Rs. 16 crores. (73)

23. It will take three to four years for these additional facilities to yield results. In the interim period, shortages will have to be met by:—

(a) promotion from lower ranks, (76)

(b) more balanced utilisation of available talent, (77)

(c) retention of persons for suitable periods beyond the age of superannuation, (78)

(d) temporary overloading, to some extent where this is not already being practised (79) and

(e) the organisation of functional training at the supervisory level. (83)

24. Functional training for supervisory personnel will have to be continued as a permanent measure, even beyond the interim period, since the additional facilities planned will meet only 60 per cent of prospective demand. (63)

25. In addition to physical shortages, rigidity in recruitment and financial procedures create difficulties. These should be suitably resolved. (82)

26. It is almost impossible to assess in quantitative terms the demand and supply of skilled craftsmen. In the circumstances, all that can be done is to indicate broadly the categories in different regions where shortages are likely to be experienced. (84 to 87)

27. Institutional training for skilled workers, present and future, should be geared to the requirements of employing authorities. (89)

28. Despite the insufficiency of information on skilled workers, it is possible to state that given the right atmosphere, engineering activities will not suffer for want of craftsmen. (90)

29. Industrial establishments should train personnel in advance to meet not only their individual needs, but also the expanding requirements of the country. (91)

30. If anticipated steel production is to find its uses, special efforts will be needed to place apprentices in the existing engineering establishments. (92)

31. Government's orders for machinery should be properly phased both in the interest of stepping up internal production and for widening the scope of apprenticeship in engineering trades. (93)

32. Training opportunities afforded by foreign consultants and suppliers of machinery should be fully utilised. (94)

33. Voluntary efforts, supported by Government, should be sufficient to meet the needs of apprenticeship training. If sufficient progress is not in evidence, legislation or levy of a cess may have to be considered. (95)

34. There is evidence to show that in the engineering field there is considerable 'flight' of personnel from job to job resulting in dislocation of work, unsatisfactory performance and increased expenditure on staff. (98)

35. 'Flight' of personnel is an organisational problem and is tied up with differences in salary scales, security of tenure and regional preferences. (101)

36. States should agree to a common line of action for the evolution of uniform conditions of service for personnel engaged on development schemes. (102)

37. The long-term interests of temporary engineers engaged on development projects should be protected. (103)

38. A suitable authority should be set up by agreement between the States and the Centre for (a) regulation of salary scales and security of tenure and (b) allocation, inter-state movement and welfare of personnel engaged on development projects outside the regular cadres. (104)

39. Flexibility and speed have to be secured in recruitment through the Public Service Commissions in the context of the personnel needs of the development programmes. (105)

40. Recruitment should be speeded up through (a) suitably strengthening the Public Service Commissions, (b) bifurcating their work relating to senior and junior posts and (c) devising simpler and quicker methods of consultation (106)

41. Recruitment to services at the college campus should be tried because of (a) the advantage of speeding up recruitment and (b) the beneficial effect which a Service Commission going round the universities will have on students. (109)

42. There should be one or two bulk selections every year for technical men of a particular category. (110)

43. Priority should be given to the creation and maintenance of a Register of Technical Manpower. (111)

44. Indian nationals receiving technical training abroad should be kept informed of employment opportunities advertised in India. (113)

45. Future recruitment policy should be guided by the need to keep in balance the age composition of serving engineers. (115)

46. The successful implementation of a manpower policy implies (a) an effective and continuous collection of the necessary information, (b) the framing of policy on the basis of information so collected and (c) the execution of such policy. Each of these functions requires a suitable organisation. (116)

47. With improved coordination among existing agencies, collection and interpretation of the necessary data on a continuing basis would not be difficult. (117)

48. A Technical Manpower Committee of the Cabinet should be set up, with a corresponding Committee of Secretaries, to evolve policies regarding technical personnel. A Technical Manpower Division should be created

in the Planning Commission to serve the Cabinet Committee.
Similar Committees will have to be set up at the State level. (119,122)

49. The Central Government should explore the possibilities of instituting a suitable All India Service of Engineers by common consent of the participating States. (123)

50. Technical and scientific personnel should be introduced at suitable levels in the general administrative machinery, especially to hold posts where their experience is of value. (124)



TABLE No. I

Outturn Figures of Degree & Diploma Holders in Engineering and Chemical Technology 1954.

S. No.	Branch of Engrg.	Northern Region		Eastern Region		Western Region		Southern Region		Total	
		Grads.	Dips.	Grads.	Dips.	Grads.	Dips.	Grads.	Dips.	Grads.	Dips.
1.	Civil	127	(5) 43,699	127	(7) 83,200	318	1-4	(3) 507 +	326	1,083	(11) 126,1439
2.	Mechanical	(1) 331 { 187 { 152 { 199 {	(6) 53 { 78 { 30 {	156 (8) 28 { 28 {	(2) 50 { 70 { 78 {	(9) 19 { 191 {	(3) 56 { 180 {	(10) 10 { 121 {	(4) 32 { 355 {	(12) 279 { 370 {	(13) 404 {
3.	Electrical	06	11	114	56	110	31	71	88	361	186
4.	Chemical Engineering & Chemical Technology	—	—	—	—	19	36	30	8	49	44
5.	Tele-com	—	—	—	—	—	—	—	—	—	—
6.	Mining	20	—	14	—	—	—	—	—	64	7
7.	Metallurgical	35	—	3	17	6	3	21	—	65	20
8.	Aeronautical	—	—	—	—	—	—	4	—	4	—

- (1) 33 graduates combined Electrical & Mechanical.
 (2) 20 graduates combined Electrical & Mechanical.
 (3) 4 in Highway Engineering.
 (4) 53 combined Electrical & Mechanical.
 (5) 43 Draftsmen.
 (6) 172 combined Electrical & Mechanical.
 (7) 83 Draftsmen.
 (8) 78 combined Electrical & Mechanical.
 (9) 19 combined Electrical & Mechanical.
 (10) 10 combined Electrical & Mechanical.
 (11) 126 Draftsmen.
 (12) 279 combined Electrical & Mechanical.

TABLE II
Statement Showing Shortages as Existing at the end of the First Five Year Plan.

S. No.	Regions or Ministries	Civil		Mechanical		Electrical		Tele-com		Others	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Northern Region	78	718	—	21	—	1	—	—	7	—
2.	Eastern Region	83	1315	6	—	3	63	—	—	12	—
3.	Western Region	721	631	10	9	2	3	1	1	—	—
4.	Southern Region	210	235	46	14	42	12	—	—	3	2
5.	Ministry of Communications	—	—	—	—	—	—	167	—	—	—
6.	Ministry of Information & Broadcasting	—	—	—	—	—	—	106	—	—	—
7.	Ministry of N.R. & S.R.	—	9	7	—	2	—	—	—	9	—
8.	Ministry of Food & Agriculture	10	1	—	—	—	—	—	—	—	11
9.	Ministry of Production	1	9	4	2	—	—	—	—	8	—
10.	Ministry of Defence	11	5	59	105	19	4	21	30	52	8
11.	Ministry of Railways	100	387	—	—	5	31	1	15	—	—
TOTAL		1214	3308	134	151	73	114	296	46	91	21

TABLE III
Additional Requirements of Engineering Personnel for the Second Five Year Plan.
ALL INDIA **Graduates & Diploma Holders.**

S. No.	Regions/Ministries	Civil		Mechanical		Electrical		Tele-com		†Mining		Metallurgical		Chemical	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Northern Region*		1516	5770	617	2486	897	2206	10	10	9	14	47	14	299	80
2. Eastern Region*		2061	7335	1125	3667	764	1919	27	17	36	26	108	31	771	223
3. Western Region*		2377	4825	700	1992	723	1782	26	20	11	15	50	15	361	184
4. Southern Region*		2583	3040	855	2102	1045	2427	9	202	10	17	52	40	295	107
5. Ministry of Production		118	91	388	306	237	235	2	—	400†	620	10	—	159	161
6. Ministry of Railways		500	1600	135	700	165	1250	—	—	—	—	—	—	—	—
7. Ministry of Iron & Steel		198	267	405	90	405	90	—	—	—	—	390	90	210	45
8. Ministry of N.R. & S.R.		85	132	50	2	17	2	54	—	3	—	4	—	36	—
9. Ministry of Food & Agriculture		56	107	35	145	2	3	1	2	—	—	—	—	10	1
10. Ministry of Communications		1	21	32	54	35	73	377	262	—	—	1	—	1	1
11. Ministry of Transport		656	830	3	—	10	90	11	—	—	—	—	—	—	—
12. Ministry of I & B		1	—	1	7	450	—	433	14	—	—	—	—	—	—
13. Ministry of Finance		—	—	15	19	6	1	6	4	—	—	—	4	1	4
14. Ministry of Defence		620	588	729	470	249	74	364	31	—	—	31	10	113	—
15. Central P.W.D.		281	1099	—	—	51	260	—	—	—	—	—	—	—	—
16. Central Water & Power Comm.		16	—	76	—	417	—	—	—	—	—	—	—	—	—
TOTAL		11114	23705	5166	12041	5473	10421	1320	562	469	692	693	204	2256	406

* Excluding requirements of Central Ministries.

† The requirements of mining graduates have not yet been finalised by the Ministry of Production. The figures are tentative. A special Committee is dealing with the question of assessment of engineering personnel requirements in this field.

‡ The requirements of Irrigation and Power Projects excluding the requirements of the Central Water and Power Commission are included in the demands shown against Regions against serial Nos. 1 to 4. The requirements of Irrigation and Power for the country as a whole are shown in Table XVIII.

TABLE IV

Additional Engineering Personnel Requirements for the Second Five Year Plan.

Northern Region. * (Excluding Requirements of Central Ministries)

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil.	205	466	314	704	298	1126	352	1548	347	1866	1516	5770
2.	Mechanical.	89	308	149	393	99	502	134	520	146	693	617	2486
3.	Electrical.	151	302	205	355	172	464	194	550	175	550	897	2206
4.	Tele-com.	1	2	5	2	1	1	1	1	2	4	10	10
5.	Mining.	1	1	3	3	2	2	1	5	3	3	9	14
6.	Metallurgical	2	—	7	1	14	1	12	5	12	7	47	14
7.	Chemical.	24	6	27	7	57	17	67	23	104	27	299	80

*Includes Punjab, Uttar Pradesh, Rajasthan, Jammu & Kashmir, P.E.P.S.U., Delhi, Ajmer and Himachal Pradesh.

TABLE V.

Additional Engineering Personnel Requirements for the Second Five Year Plan.

Eastern Region.* (Excluding Requirements of Central Ministries)

No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan Period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil.	272	389	408	945	389	1316	436	1913	345	2572	2001	7335
2.	Mechanical.	128	333	202	463	172	591	261	925	342	1353	1125	3667
3.	Electrical.	105	198	170	318	123	315	168	471	195	617	764	1919
4.	Tele-com.	6	1	13	1	1	4	1	3	1	2	27	17
5.	Mining.	9	2	16	6	3	5	4	6	4	7	36	26
6.	Metallurgical.	3	—	19	4	35	2	34	12	33	16	108	31
7.	Chemical.	62	16	69	29	146	12	224	65	270	78	771	223

*Includes Assam, West Bengal, Bihar, Manipur and Tripura.

TABLE VI

Additional Engineering Personnel Requirements for the Second Five Year Plan.

Western Region. * (Excluding Requirements of Central Ministries)

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil.	346	661	306	822	478	964	539	1163	618	1215	2977	4825
2.	Mechanical.	102	196	135	307	157	333	163	483	162	673	760	1992
3.	Electrical.	137	257	151	307	152	365	160	435	123	418	723	1782
4.	Tele-comm.	3	3	9	4	5	6	4	3	5	4	26	20
5.	Mining.	1	2	3	4	3	2	1	5	3	2	11	15
6.	Metallurgical	3	—	7	1	11	1	16	5	13	8	30	15
7.	Chemical.	29	37	32	30	69	19	105	46	126	52	361	184

* Includes Bombay, Madhya Pradesh, Madhya Bharat, Kutch, Bhopal & Vindhya Pradesh.

TABLE VII.
Additional Engineering Personnel Requirements for the Second Five Year Plan.
Southern Region.* (Excluding Requirements of Central Ministries)

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan Period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil.	538	468	471	555	557	746	505	665	512	606	2583	3040
2.	Mechanical.	136	258	130	316	160	362	200	491	229	675	855	2102
3.	Electrical.	162	304	156	299	191	424	235	603	302	797	1046	2427
4.	Tele-com.	1	17	3	39	2	40	1	53	2	70	9	262
5.	Mining.	1	2	3	4	3	3	1	2	2	6	16	17
6.	Metallurgical.	3	—	10	2	12	5	14	17	13	16	52	40
7.	Chemical.	24	23	27	10	56	17	85	26	103	31	295	107

*Includes Madras, Andhra, Mysore, Travancore-Cochin, Hyderabad & Coorg.

TABLE VIII
Additional Engineering Personnel Requirements for the Second Five Year Plan.
Ministry of Production.

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan Period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil.	30	5	24	8	22	15	22	26	—	37	118	91
2.	Mechanical.	119	84	40	46	39	67	78	60	62	49	388	306
3.	Electrical.	30	19	33	15	61	53	59	75	34	73	237	235
4.	Tele-com.	1	—	1	—	—	—	—	—	—	—	2	—
5.	Mining.	38	62	62	93	80	124	100	135	120	186	400	620
6.	Metallurgical.	—	—	1	—	1	—	—	—	8	—	10	—
7.	Chemical.	46	79	32	44	33	38	—	—	8	—	139	161

TABLE No. IX
Additional Engineering Personnel Requirements for the Second Five-Year Plan.
Ministry of Railways.

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960—61		Total for the Plan period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil	150	500	125	450	100	250	75	200	50	200	500	1600
2.	Mechanical.	30	175	30	175	25	150	25	100	25	100	135	700
3.	Electrical.	50	350	50	350	25	250	20	150	20	150	165	1250

TABLE No. X
Additional Engineering Personnel Requirements for the Second Five Year Plan.
Ministry of Iron & Steel.

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960-61		Total for the Plan Period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil	67	91	66	88	65	88	—	—	—	—	198	267
2.	Mechanical.	135	30	135	30	135	30	—	—	—	—	405	90
3.	Electrical.	135	30	135	30	135	30	—	—	—	—	405	90
4.	Chemical.	71	16	71	16	68	13	—	—	—	—	210	45
5.	Metallurgical.	132	31	130	30	128	29	—	—	—	—	390	90

TABLE XI

Additional Engineering Personnel Requirements for the Second Five Year Plan.

Ministry of NR & SR

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan Period	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil.	9	9	8	15	19	29	23	35	26	44	85	132
2.	Mechanical.	7	1	5	1	12	—	14	—	12	—	50	2
3.	Electrical.	1	—	3	—	4	2	5	—	4	—	17	2
4.	Tele-comm.	7	—	10	—	11	—	14	—	12	—	54	—
5.	Mining.	—	—	—	—	1	—	1	—	1	—	3	—
6.	Metallurgical	—	—	—	—	1	—	2	—	1	—	4	—
7.	Chemical.	11	—	9	—	7	—	8	—	3	—	38	—

TABLE XII

Additional Engineering Personnel Requirements for the Second Five Year Plan.

Ministry of Food & Agriculture.

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan Period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil.	19	34	10	20	10	35	11	23	6	15	56	107
2.	Mechanical.	15	78	4	20	6	27	7	12	3	8	35	145
3.	Electrical.	1	1	1	2	—	—	—	—	—	—	2	3
4.	Tele-com.	1	1	—	1	—	—	—	—	—	—	1	2
5.	Chemical.	8	1	2	—	—	—	—	—	—	—	10	1
6.	Agricultural.	19	—	11	—	10	—	10	—	10	—	60	—

TABLE XIII.

Additional Engineering Personnel Requirements for the Second Five Year Plan.

Ministry of Communications.

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan Period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil.	—	1	1	2	—	4	—	6	—	8	1	21
2.	Mechanical.	4	13	3	9	7	11	10	11	8	10	32	54
3.	Electrical.	4	5	3	3	8	15	10	18	10	30	36	73
4.	Tele-com.	42	54	51	59	70	48	96	53	118	48	377	862
5.	Metallurgical.	1	—	—	—	—	—	—	—	—	—	1	—
6.	Chemical.	—	—	1	1	—	—	—	—	—	—	1	1
7.	Aeronautical.	21	—	22	—	28	—	35	—	33	130	189	—

TABLE XIV.
Additional Engineering Personnel Requirements for the Second Five Year Plan.
Ministry of Transport.

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan Period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil.	44	40	60	106	108	123	171	197	273	364	656	830
2.	Mechanical.	1	—	1	—	1	—	—	—	—	—	3	—
3.	Electrical.	2	4	2	7	3	26	8	33	—	20	10	90
4.	Tele-com.	3	—	2	—	2	—	3	—	1	—	11	—

TABLE No. XV
Additional Engineering Personnel Requirements for the Second Five Year Plan.
Ministry of I & B.

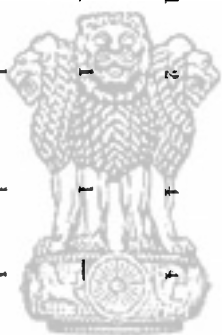
S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan Period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil	—	—	—	—	—	—	—	—	—	—	1	—
2.	Mechanical.	—	7	—	—	—	—	—	—	—	—	1	7
3.	Electrical.	84	—	—	—	82	—	115	—	118	—	450	—
4.	Telecom.	105	6	63	4	72	3	37	2	101	—	433	14

TABLE XVI

Additional Engineering Personnel Requirements for the Second Five Year Plan.

Ministry of Finance.

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan Period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Mechanical.	2	2	1	2	4	4	5	6	3	5	15	19
2.	Electrical.	1	—	1	1	1	—	2	—	1	—	6	1
3.	Tele-comm.	—	1	1	1	1	1	2	1	2	—	6	4
4.	Chemical.	—	1	—	1	1	1	—	1	—	—	1	4
5.	Metallurgical.	—	—	—	—	—	1	—	2	—	1	—	4



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TABLE XVII
Additional Engineering Personnel Requirements for the Second Five Year Plan.
Ministry of Defence

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan Period	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil.	69	81	77	120	102	124	157	113	215	150	620	588
2.	Mechanical.	70	125	77	97	136	90	203	66	243	92	729	470
3.	Electrical.	27	13	26	13	47	15	68	11	81	22	249	74
4.	Tele-com.	30	6	52	6	85	7	91	4	106	8	364	31
5.	Metallurgical.	6	—	12	1	7	2	6	5	—	2	31	10
6.	Chemical.	3	—	24	—	12	—	21	—	22	—	113	—
7.	Aeronautical	9	—	8	—	12	—	25	—	37	—	91	—



1800	500	2000	4000
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TABLE XIX
Additional Engineering Personnel Requirements for the Second Five Year Plan.
C. P. W. D.

S. No.	Branch of Engg.	1956 — 57		1957 — 58		1958 — 59		1959 — 60		1960 — 61		Total for the Plan Period.	
		Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips
1.	Civil.	26	72	28	105	51	190	74	307	102	425	281	1099
2.	Electrical.	5	20	4	18	10	43	14	68	18	120	51	269

TABLE XX

All-India Outturn and Intake Figures of Degree Holders in Engineering, Chemical Technology and Architecture.

S. No.	Branch of Engineering	Estimated Figures																			
		1951		1952		1953		1954		1955		1956		1957		1958		1959		1960	
		O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.
1.	Civil	860	1696	1019	1714	960	1915	1083	1902	1360	2180	1371	2280	1632	2536	1522	2430	1744	2730	1864	2730
2.	Mechanical	508	831	546	916	546	984	870	995	665	1125	733	1185	797	1306	704	1300	900	1400	960	1400
3.	Electrical	555	912	400	958	410	1033	555	1004	730	1140	766	1190	828	1315	605	1315	912	1415	972	1415
4.	Mechanical and Electrical (Combined)	91	158	107	64	108	—	53	—	126	—	61	—	—	—	—	—	—	—	—	—
5.	Electrical Comm./Tele Comm./ Radio Engg./Electronics	46	74	86	71	77	75	40	102	60	100	57	100	60	130	82	130	80	130	80	190
6.	Architecture	7	46	4	96	9	160	18	223	37	225	77	225	128	223	178	225	180	225	180	225
7.	Automobile	—	20	24	24	23	30	18	30	16	30	19	30	24	30	24	30	24	30	24	30
8.	Aeronautical	—	20	24	5	6	30	4	12	16	25	4	20	24	30	10	40	16	20	16	20
9.	Mining	30	56	50	51	130	59	64	55	45	60	41	60	47	60	44	60	48	60	48	60
10.	Metallurgy	38	60	36	73	37	74	65	60	48	70	58	70	59	90	55	90	56	130	58	130
11.	Chemical Engineering and Chemical Technology	274	517	359	655	375	550	361	578	414	593	444	613	440	613	463	660	474	760	490	760

TABLE XXI

All-India Outturn and Intake Figures of Diploma Holders in Engineering, Chemical Technology and Architecture

All-India Outturn and Intake Figures																							
S. No.	Branch of Engineering	1951		1952		1953		1954		1955		1956		1957		1958		1959		1960		1961	
		O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.	O.T.	I.T.
Estimated Figures																							
1.	Civil	1110	2808	1053	2746	1357	3089	1565	3824	2061	4400	2318	4400	2868	4650	3300	5130	3300	5450	3488	5450	3863	5450
2.	Mechanical	433	843	383	944	377	994	494	1108	707	1160	748	1160	831	1285	870	1536	870	1685	964	1685	1152	1685
3.	Electrical	397	820	369	943	313	779	370	1067	707	1120	885	1120	800	1245	840	1436	840	1645	934	1645	1122	1645
4.	Mechanical and Electrical	287	510	254	551	211	49	279	719	413	720	487	720	549	720	540	720	540	720	540	720	540	720
5.	Electrical Comm./Tele Comm./Radio Engg./Electronics	36	105	66	105	24	106	44	96	78	100	80	100	74	100	75	100	75	100	75	100	75	100
6.	Architecture	9	103	8	96	16	89	22	58	74	60	67	60	40	60	45	60	45	60	45	60	45	60
7.	Automobile	75	250	98	251	70	289	121	350	188	350	217	350	263	350	262	350	262	350	262	350	262	350
8.	Mining	3	10	12	21	7	22	7	22	15	25	16	25	16	25	19	25	19	25	19	25	19	25
9.	Metallurgy	35	35	20	25	21	25	20	27	19	25	19	25	21	25	19	25	19	25	19	25	19	25
10.	Chemical Engineering and Chemical Technology	135	298	117	265	83	221	186	188	212	160	177	140	150	140	130	140	110	140	110	140	110	140

TABLE XXII

Engineers Trained in Industrial Establishments in 1954.

S. No.	Branch of Engineering	Northern Region	Eastern Region	Western Region	Southern Region	Total
1.	Civil	1	8	1	12	22
2.	Mechanical	122	295	81	257	755
3.	Electrical	28	189	29	128	374
4.	Tele-com	10	—	—	22	32
5.	Automobile	—	7	5	221	233
6.	Aeronautical	—	—	—	25	25
7.	Marine	—	19	24	—	43
8.	Chemical	—	15	—	56	71
9.	Metallurgical	—	23	2	15	40
10.	Mining	—	94	—	—	94
11.	Surveyors	—	19	—	—	19

Note :—The figures indicate the total number of engineering graduates and diploma holders who completed apprentice training in industrial undertakings (public & private) in 1954.

TABLE XXIII
Engineering Personnel Requirements for the Second Five Year Plan. **All India**
Demand and Supply **Graduates**

Sl. No.	Branch of Engineering	1956-57			1957-58			1958-59			1959-60			1960-61		
		Demand	Supply	Deficit (d)	Demand	Supply	Deficit (d)	Demand	Supply	Deficit (d)	Demand	Supply	Deficit (d)	Demand	Supply	Deficit (d)
1.	Civil	1814	1371	443	2000	1532	468	2200	1522	678	2400	1744	656	2706	1864	836
2.	Mechanical	851	759	180	923	787	136	1003	796	241	1133	900	282	1251	960	291
		88(a)			20(a)			34(a)			44(a)					
3.	Electrical	952	791	304	1022	826	356	1089	803	454	1171	912	479	1289	972	267
		143(b)			160(b)			168(b)			220(b)					
4.	Tele-com.	200	37	143(b)	220	60	160(b)	250	82	168(b)	300	80	220(b)	350	80	270
5.	Mining (g)	52	41	11	87	47	40	92	44	48	108	48	60	132	48	84
6.	Metallurgical	150	58	92(c)	180	59	121(c)	199	55	144(e)	244	56	28(e)	80	56	24
7.	Chemical (including Chemical Technology)	311	444	-41	312	440	-48(f)	460	463	102(f)	528	474	82	638	490	146
		92(e)			121(c)			144(e)			20(e)					
8.	Aeronautical	30	4	26(c)	30	24	6	40	10	30(c)	60	16	44(c)	70	16	54(c)

- (a) Figures added represent the probable number of mechanical graduates which may help fill the deficits in agricultural and aeronautical fields.
- (b) Deficit of tele-com engineers for the first four years may be met by recruiting electrical engineering graduates and giving them departmental training in telecommunications. Figures added in demand columns against electrical, represent this transfer.
- (c) Deficit of aeronautical engineers for the first four years may be filled by recruiting unemployed aeronautical graduates. If necessary, some mechanical engineering graduates may also be recruited and given departmental training in aeronautical engineering.
- (d) Deficit of civil, mechanical, electrical and tele-com engineers for the first four years will have to be met mainly by accelerated promotion of overseers. During the fifth year deficits may be met from the output of the additional graduate training arrangements recommended in this report. Deficit in case of mining engineers during the whole of the Plan will have to be met mainly by accelerated promotion of supervisors. Only towards the last year of the Plan extra output will be available from the additional graduate training arrangements recommended in this report.
- (e) Figures added represent the probable transfer of chemical engineers for meeting shortage of metallurgical engineers.
- (f) Deficit is calculated by taking into account the surplus of the previous years. Deficit of chemical engineers and technologists towards the later years of the Plan may be met by accelerated promotion of supervisors and by employing chemists who may be given departmental training in chemical engineering and chemical technology.
- (g) The requirements of mining graduates have not yet been finalised by the Ministry of Production. The figures are tentative. A special Committee is dealing with the question of assessment of engineering personnel requirements in this field.

TABLE XXIV
Engineering Personnel Requirements for the Second Five Year Plan.
Demand and Supply

All India
Diploma Holders

Sl. No.	Branch of Engineering	1956-57				1957-58				1958-59				1959-60				1960-61			
		Demand	Supply	Deficit (c)	Demand	Supply	Deficit (c)	Demand	Supply	Deficit (c)	Demand	Supply	Deficit (c)	Demand	Supply	Deficit (c)	Demand	Supply	Deficit (c)		
1.		3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.					
1.	Civil.	3005 + p(443)	2318	687 + p(443)	400 + p(468)	2868	1132 + p(468)	5000 + p(678)	3300	1700 + p(678)	6200 + p(678)	3300	2900 + p(636)	7300 + p(836)	3488	4012 + p(836)					
2.	Mechanical (d)	1612 + p(180)	1209	403 + p(180)	859 + p(66)	1364	495 + p(156)	2197 + p(241)	1402	765 + p(241)	2744 + p(282)	1402	1342 + p(282)	3039 + p(391)	1406	2143 + p(291)					
		(b)			(b)			(b)													
3.	Electrical	1503+10 + p(304)	1128	385 + p(304)	1700 + p(356)	1970	636 + p(356)	2002+35 + p(454)	1110	927 + p(454)	2414 + p(479)	1110	1304 + p(479)	2802 + p(267)	1204	1598 + p(267)					
4.	Tele-com	90	80	10(b)	100	74	26(b)	110	75	33(b)	120	75	45	142	75	67					
5.	Mining (e)	69	16	53	110	16	94	136	19	117	173	19	154	204	19	185					
6.	Metallurgical	31	19	12(a)	36	21	15(a)	41	19	22(a)	46	19	27	50	19	31					
7.	Chemical	181+ 12(a)	177	16	129+ 15(a)	150	(—)6	147+ 22(a)	130	39	161	110	51	188	110	78					

Figures added represent the probable vacancies caused by promotion of overseers to officers. Prefix 'p' with a figure means that 'portion' of the number which is desired to be promoted. These promotions have reference to the table for Graduates (Table - XXIII)

(a) Figures added represent the probable number of chemical diploma-holders which may help fill the deficit on the metallurgical engineering side

(b) Deficit of tele-com diploma-holders for the first three years may be met by recruiting electrical diploma-holders and giving them departmental training in telecommunications. Figures added in demand columns against electrical represent this transfer.

(c) Deficit during the first year will have to be met mostly by promotion of practical hands and to some extent by retention of supernannuated overseers. Arrangements for training personnel who are normally at least matriculates, for short-term training, as well as extra arrangements for increasing the output of regular diploma-holders (extra to even what are planned) will have to be made immediately. Deficit during the second year will have to be met by (1) promotion of practical hands, (2) retention of supernannuated overseers, (3) output of personnel with short-term training. From third year onwards some regular trainees would be available if arrangements recommended by the Committee are made immediately.

(d) Includes automobile diploma-holders.

(e) Figures of demand are tentative. A special Committee is dealing with the question of assessment of engineering personnel requirements in this field.

TABLE XXV

*Region wise Distribution of the Additional Requirements of Engineering Personnel.

S. No.	Branch of Engineering	Northern	Eastern	Western	Southern	Total
GRADUATES						
1.	Civil	270	490	250	40	1050
2.	Mechanical	30	250	130	40	450
3.	Electrical	70	180	140	60	450
4.	Tele-com	80	110	40	40	270
5.	Mining**	25†	50†	—	—	75
6.	Metallurgy	16	—	17	17	50
DIPLOMA HOLDERS						
1.	Civil	680	1480	740	—	2900
2.	Mechanical	540	810	220	30	1600
3.	Electrical	540	420	120	220	1300
4.	Tele-com	—	—	10	40	50
5.	Mining**	—	90	60	—	150
6.	Metallurgical	—	9	14	17	40



*The regions adopted are the same as the four regions of the All India Council for Technical Education.

†This increase is intended by increasing the outturn from Benares University.

‡This increase is intended by increasing the outturn from Indian School of Mines & Geology, Dhanbad.

DEMARCATON OF REGIONS :

Northern :- Punjab, Uttarpradesh, Rajasthan, Jammu & Kashmir, P.E.P.S.U., Delhi, Ajmer-Marwara & Himachal Pradesh.
 Eastern :- Assam, West Bengal, Bihar, Orissa, Manipur & Tripura.
 Western :- Bombay, Madhya Pradesh, Madhya Bharat, Kutch, Bhopal & Vindhya Pradesh.
 Southern :- Madras, Andhra, Mysore, Travancore-Cochin, Hyderabad & Coorg.

**Please refer to note (g) of table XXIII.

To be published in Part I, Section I of the Gazette of India.

PLANNING COMMISSION

RESOLUTION

New Delhi, 26th September, '55

No, PC (VI) L (E) III-15/55.

The Planning Commission is at present engaged in the preparation of the Second Five Year Plan and problem of securing the necessary trained personnel especially with engineering qualifications required in several fields of economic activity such as irrigation and power projects, road development, building programmes, industrial and mineral developments etc. calls for a speedy solution. The Technical Personnel Committee for River Valley Projects which has done considerable work on the subject, so far as the irrigation and power programmes are concerned, has come to the conclusion that it is necessary to take a wider view of the problem and that it is not sufficient to look at the question of engineering personnel merely sector by sector. While some work is being done in this direction in other Ministries also and in the States, a co-ordinated assessment of the situation requires to be urgently made. It has therefore, been decided to set up an Engineering Personnel Committee consisting of:—

Chairman

Shri Y.N. Sukthankar,
Secretary, Planning Commission.

Members

1. Shri Vishnu Sahay,
Secretary, Ministry of Labour.
2. Shri Kanwar Sain,
Chairman, C. W. & P. C.
3. Shri S. B. Bapat,
Jt. Secretary, Ministry of Home Affairs.
4. Shri S. Ranganathan,
Jt. Secretary, Ministry of W. H. & S.
5. Shri K. N. Subramanian,
Jt. Secretary, Planning Commission.
6. Shri K. P. Mushran,
Member, Staff, Railway Board.
7. Prof. M. S. Thacker,
Director, Council of Scientific & Industrial Research.
8. Shri H. P. Mathrani,
Jt. Secretary, Ministry of Transport.
9. Shri G. K. Chandiramani,
Special Officer (Technical),
Ministry of Education.
10. Dr. B. D. Kalelkar,
Industrial Adviser (Engg.),
Ministry of Commerce & Industry.

Secretary.

Shri B. N. Datar,
Director, Labour & Employment,
Planning Commission.

3. The terms of reference of the Committee will be:—

- (1) To make a general assessment of shortages of supervisory and higher grades of engineering personnel anticipated at the end of the First Five Year Plan
- (2) To estimate the probable requirements of engineering personnel of supervisory and higher grades for implementing the Second Five Year Plan in the principal fields of national development, such as building and road construction, railways, industrial development in the public and private sectors, mining and irrigation and power etc.
- (3) To review the programme of the Central and State Governments under the Second Five-Year Plan for the expansion and development of facilities for technical education for engineering personnel of supervisory and higher grades and to recommend such additional or modified programmes as may be considered necessary.
- (4) To review existing facilities for practical training in industrial establishments, including apprenticeships and to recommend measure of their expansion in cooperation with industry, and
- (5) to make such other recommendations as may be essential for ensuring the adequate supply of engineering personnel for the next fifteen years with particular reference to the immediate requirements of the Second Five-Year Plan.

4. The Committee may constitute sub-committees and coopt members.

5. The Committee as a whole, or in part, may meet as often at New-Delhi or any other place as may be decided by the Chairman.

6. The Committee should submit its interim recommendations to the Planning Commission by the end of December, 1955 and the final recommendations by 31st March, 1956.

Order.

Ordered that a copy of this Resolution be published in Gazette of India and be communicated to all concerned.

Sd/- Y. N. Sukthankar
Secretary, Planning Commission.

To

The Manager,
Government of India Press,
New Delhi.

Copy forwarded to:-

1. Accountant General, Central Revenues New Delhi.
2. All Ministries of the Govt. of India.
3. All State Governments.
4. The Secretary,
Employers' Federation of India,
'Bombay House,' Bruce Street, Fort, Bombay.
5. The Secretary,
All-India Organisation of Industrial Employers,
28, Ferozeshah Road, New Delhi.

Sd/- (K. Sachidanandam)
UNDER SECRETARY TO THE GOVERNMENT OF INDIA

APPENDIX B

Form E.P.—I

Engineering Personnel Requirements for the Second Five Year Plan.

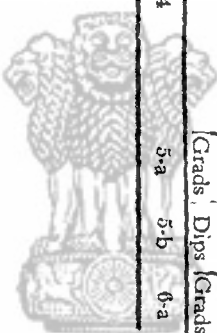
Ministry/Department _____

Name of Project _____

Location _____

Date of report _____

Serial No.	*Occupational Title	Code No. (Not to be filled by report- ing authority)	Shortages existing as on 31st March, 1956	Additional manpower requirements during the year										Total for the Plan period	
				1956-57	1957-58	1958-59	1959-60	1960-61							
1	2	3	4	5-a	5-b	6-a	6-b	7-a	7-b	8-a	8-b	9-a	9-b	10-a	10-b
				Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips	Grads	Dips



*See Occupational List and Instructions.

Note:—Under columns (5) to (10) give figures separately for (a) Grads., i.e. Graduates, including Post-graduates, and (b) Dips., i.e. Diploma Holders or equivalents.

INSTRUCTIONS FOR FILLING FORM EP-I

1. Figures regarding future manpower requirements in respect of each development project should be entered in attached form. For purposes of this return, personnel have been classified as shown in the List of Occupational Titles. The standard list forwarded herewith contains broad groups as well as the specific titles, detailed under each of them. The list is by no means comprehensive and should be supplemented, where necessary.

2. Please read the occupational list carefully and then mark on it those occupations in which persons are employed or will be employed in a particular project or group of projects. Any occupational title not already specified in the list may be added at the end of the appropriate group, heading and sub-heading.

3. After all the occupations that relate to the project under reference have thus been marked on the list, and additions made where necessary, they should be entered on the attached form EP-I under the appropriate groups, headings and sub-heading and separate figures should be given as required against each specific occupation or trade. (Additional sheets may be used as necessary).

4. Contract personnel should be included for purposes of this return but should be shown on separate forms marked "Contract Personnel."

5. When completing columns 5-10, please give the number of additional personnel required (i. e. in addition to the previous year's strength) in connection with the project during the period specified. If figures are not available year by year the total number required during the period of the Second Plan may be given.

6. A separate return should be submitted in respect of each major project. Smaller projects may be grouped together. Returns are required in respect of existing projects that will carry over into the 2nd Plan period as well as new projects under the 2nd Plan.

7. A separate note should be attached to the completed return giving the numbers, if any, likely to become surplus to requirements in various categories and the years during which may become surplus.

8. A note should also be furnished on the categories of personnel in respect of which shortage is being experienced.

PLANNING COMMISSION
ENGINEERING PERSONNEL COMMITTEE
CLASSIFIED LIST OF OCCUPATIONAL TITLES

1 Professional and Technical Occupations.

I. A. Engineers:

I. A. 1	Engineers, Civil
I. A. 2	Engineers, Building construction
I. A. 3	Engineers, Highway
I. A. 4	Engineers, Irrigation
I. A. 5	Engineers, Hydraulics
I. A. 6	Engineers, Sanitary/Public Health
I. A. 7	Engineers, Structural
I. A. 8	Engineers, Electrical
I. A. 9	Engineers, Illumination
I. A. 10	Engineers, Traction
I. A. 11	Engineers, Tele-communication
I. A. 12	Engineers, Sound
I. A. 13	Engineers, Power
I. A. 14	Engineers, Mechanical
I. A. 15	Engineers, Air Conditioning & Refrigeration
I. A. 16	Engineers, Agricultural (Soil & Water Conservation, Farm Power & Machinery)
I. A. 17	Engineers, Locomotive
I. A. 18	Engineers, Aeronautical
I. A. 19	Engineers, Automobile
I. A. 20	Engineers, Combustion
I. A. 21	Engineers, Marine.
I. A. 22	Naval Architects
I. A. 23	Instrument Technologists
I. A. 24	Engineers, Industrial
I. A. 25	Engineers, Production
I. A. 26	Engineers, Chemical
I. A. 27	Engineers, Mining (Coal, Metal, Petroleum)
I. A. 28	Engineers Metallurgical
I. A. 29	Engineers, Sugar
I. A. 30	Engineers, Lubrication
I. A. 31	Architects (Building & Landscape)
I. A. 32	Town Planners
I. A. 33	Surveyors.

I. C. Scientists

I. C. 12 Geologists and Mineralogists

I. C. 13 Metallurgists.

5. Agriculture, Animal Husbandry, Forestry, Fishery and Related Occupations.

5. 1 Farm Machinery Operators

5. 2 Tractor Operators

6. Mining, Quarrying and Well Drilling Occupations.6. A. Coal Mining.

6. A. 2 Underground workers, Drillers

6. A. 5 Surface Workers, Drillers

6. B. Metal Mining.

6. B. 2 Underground workers, Drillers.

6. B. 3 Surface workers, Drillers.

6. C. Other Mining

6. C. 1 Underground Workers, Drillers

6. C. 3 Surface workers, Drillers.

6. D. Quarrying

6. D. 3 Drillers, Machine

6. E. Well-Drilling.

6. E. 1 Drillers, Well-boring.

7. Operating Transport Occupations:7. C. Water Transport

7. C. 3 Drivers (Motor Boat)

7. C. 4 Drivers (Steam Boat)

7. C. 5 Pilots (Waterways)

7. D. Air Transport :

7. D. 1 Air Pilots.

8. Manufacturing, Processing and Related Occupations (including Crafts).8. B. Cement :

8. B. 1 Burners

8. B. 2 Millers

8. B. 3 Gaugers.

8. C. Engineering and Metal Trades

- 8. C. 1 Forgemen
- 8. C. 2 Furnacemen
- 8. C. 3 Moulders (foundry)
- 8. C. 4 Boiler makers.
- 8. C. 5 Boiler attendants.
- 8. C. 6 Fitters
- 8. C. 7 Turners
- 8. C. 8 Machinists.
- 8. C. 9 Grinders.
- 8. C. 10 Welders
- 8. C. 11 Rivetters.
- 8. C. 12 Blacksmiths.
- 8. C. 13 Millers (metal)
- 8. C. 14 Drillers (metal)
- 8. C. 15 Sheet metal workers.
- 8. C. 16 Tool makers.
- 8. C. 17 Pattern makers (metal)
- 8. C. 18 Pattern makers (wood)

8. D. Electrical :

- 8. D. 1 Electricians.
- 8. D. 2 Electric Fitters.
- 8. D. 3 Armature winders.
- 8. D. 4 Linesmen.
- 8. D. 5 Cable Jointers.
- 8. D. 6 Wiremen.

8. E. Construction and Building.

- 8. E. 1 Stone Cutters.
- 8. E. 2 Masons and Brick Layers.
- 8. E. 3 Carpenters.
- 8. E. 4 Plumbers.
- 8. E. 5 Painters.
- 8. E. 6 Glaziers.
- 8. E. 7 Excavating Machine Operators.
- 8. E. 8 Construction Machine Operators.
- 8. E. 9 Riggers.
- 8. E. 10 Crane Operators.
- 8. E. 11 Brick Moulders.

8. K. General (Any Industry / Profession) :

- 8. K. 1 Draftsmen.
- 8. K. 2 Tracers.

APPENDIX C.

PLANNING COMMISSION

(Engineering Personnel Committee)

POINTS FOR DISCUSSION WITH THE MINISTRIES.

1. Is there any information on the strength of the existing cadres, at different levels, in the departments/projects under the Ministry ?
2. If detailed information is not available for all levels, what is the level up to which such information would be readily available ?
3. Have the Ministry recalled retired engineering personnel into service ? What is the extent of such recall ? Even after recall of retired men, how much of such personnel is still in short supply in different categories ?
4. Have the Ministry gone into the causes behind these short supplies ? What are the Ministry's suggestions for overcoming these shortages ?
5. Have the Ministry assessed their requirements of engineering personnel over the next five years for (a) the construction phase and (b) the continuing phase ? If so, has the assessment been made for each year separately ?
6. What allowance has been made for the superannuation of the existing personnel in such assessment ?
7. During the construction phase, is the work given to any extent on a contract basis ? Does the extent of such contract work differ from region to region ?
8. On what basis is the overall assessment made ? Is it on the basis of cost or is it on the basis of physical targets ?
9. What allowance is made for technological changes in working out the assessment ?
10. Do the Ministry find any difficulty in adjusting the regional preferences shown by their staff ? What are their arrangements for overcoming such difficulties ?
11. Are the requirements worked out on a regional basis ? Is there any difficulty in recruiting personnel in specific regions ? What are the categories in which such difficulties are experienced ? (Information is required region-wise).
12. What are the normal avenues of recruiting the staff required for Ministry on the engineering side ?
13. Have the Ministry definite suggestions to offer in the matter of improving the quality of trained engineering personnel available for absorption ?
14. If recruits are raw, what is the arrangement for training ? What is the wastage during the training period ?
15. To what extent is it possible for the Ministry to cope with their demand for training personnel ? In case it is not possible to meet the demand in full, on what agencies would the Ministry depend for such training ? Specifically, could the training in Ordnance Factories be utilised for work under the Ministry ?
16. If the training establishments of the Ministry have developed excess capacity or are likely to develop it, in what branches of engineering could the excess be absorbed, e. g. light engineering, heavy engineering and so on.

APPENDIX D.

Questionnaire for

{ Indian Engineering Association
Engineering Association of India

1. What will be the additional requirements in terms of personnel (in list 'A') of the members of the association ?
2. What is the method by which the estimate of additional requirements of personnel is worked out by your members ?
3. What percentage of the total expenditure on construction projects goes towards the pays of the engineering supervisory staff ? What is the average ratio between the engineering graduates, diploma-holders and practical hands without diploma or degree, amongst the supervisory staff ? (The term "supervisory" includes supervisors, foremen & officers).
4. What is the annual output of apprentices in various trades ? In what numbers will the association be able to give practical training to Engineering Personnel in the Public Sector every year ? How can this out-turn be augmented with short notice ? In the training of engineering personnel what is the wastage experienced by your members?
5. What are the types of contracts which the members of the association accept from Govt ? What is the limit below which the association members do not tender ?
6. Assuming that during the Second Five Year Plan the total amount of contractual work offered by the Govt. is about twice the amount of contractual work offered during the First Plan, will the firms be able to handle the same ? If not, to what extent additional work can be undertaken by the firms ?
7. What is the method of recruitment of engineering personnel adopted by the members of the association ? Do they find any of the categories mentioned in list in short supply ? Are there any difficulties regarding recruitment in certain regions, and if so, for what categories ? What incentives do you consider necessary for encouraging mobility of engineering personnel
8. Shri B. M. Birla had stated in his presidential address to the Federation of Indian Chambers of Commerce and Industry on March 5, 1955 that to run properly a large engineering unit, at least 100 engineers, foremen designers and draftsmen would be required. He explained that it meant, therefore, that to man, say, 250 factories in the metal processing industries alone 25,000 technical men would be necessary. What are the views of the association on the above ?
9. What complement of staff (Ref : list A) is needed for the using of 5,000 tons of steel per annum ? (for different types of uses) .
10. To what extent can the capacity of private sector for machine building be increased by end of the Second Plan ? What advance arrangements

are needed to increase the capacity-in terms of personnel ?

11. It is reported that training a foreman takes about 5 years. What is the number of persons being trained as foremen at present ? What numbers will be trained in the future ?

12. Is there any evidence to indicate that the quality of engineering personnel available to the members of the association has changed ? If it has deteriorated what can be done to improve the quality ?

13. What are the comments of the association on the interim recommendations of the Committee ?



LIST A.

LIST OF OCCUPATIONAL TITLES.

I. *Graduates and Diploma Holders in the following Branches of Engineering*

1. Civil
2. Mechanical
3. Electrical
4. Chemical
5. Telecom
6. Mining
7. Metallurgical
8. Marine Engineering and Naval Architecture
9. Aeronautical
10. Agricultural
11. Automobile
12. Town Planning
13. Architecture

II. *Graduates and Diploma Holders in Chemical Technology.*

III. *"Skilled" Staff.*

8. C. Engineering and Metal trades.

8. C. 1 Forgemen
8. C. 2 Furnacemen
8. C. 3 Moulders (foundry)
8. C. 4 Boiler makers
8. C. 5 Markers
8. C. 6 Fitters
8. C. 7 Turners
8. C. 8 Machinists
8. C. 9 Grinders
8. C. 10 Welders
8. C. 11 Rivetters (including structural rivetters)
8. C. 12 Black-smiths
8. C. 13 Millers (metal)
8. C. 14 Drillers (metal)
8. C. 15 Sheet metal workers
8. C. 16 Tool makers
8. C. 17 Pattern makers (metal)
8. C. 18 Pattern makers (wood)

- 8. C. 19 Blacksmiths (power-hammer)
- 8. C. 20 Capstan lathe operators
- 8. C. 21 Millwrights
- 8. C. 22 Instrument Mechanics

8. D. Electrical.

- 8. D. 1 Electricians
- 8. D. 2 Electric fitters
- 8. D. 3 Armature winders
- 8. D. 4 Linesmen
- 8. D. 5 Cable jointers
- 8. D. 6 Wiremen
- 8. D. 7 Refrigerator Mechanics
- 8. D. 8 Radio Mechanics

8. E. Construction & Building.

- 8. E. 4 Plumbers.

8. F Iron and Steel Plants.

- 8. F. 1 Refractory Masons.

8. K. General (Any industry / profession)

- 8. K. 1 Draftsmen
- 8. K. 2 Tracers
- 8. K. 3 Surveyors (other than diploma-holders and graduates)
- 8. K. 4 Sub-overseers
- 8. K. 5 Estimators
- 8. K. 6 Computers.

APPENDIX E.

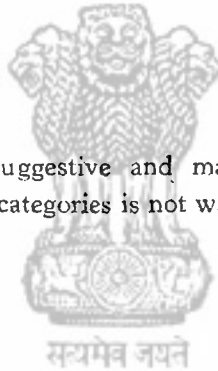
QUESTIONNAIRE FOR BUILDERS' ASSOCIATION.

1. What are the types of contracts which the members of the association accept ? What is the limit below which the association members do not tender ?
2. Assuming that during the Second Five Year Plan the emphasis on work by contract will remain the same as in the last five years, what will be the additional requirements in terms of personnel (in list 'A') of the members of the association?
3. What is the method by which the estimate of additional requirements of personnel is worked out by your members ?
4. The "norms" that the Committee has used are appended. What are the views of the association on these norms ?
5. What is the method of recruitment of engineering personnel adopted by the members of the association ? Do they find any of the categories mentioned in the list in short supply ?
6. Is there any evidence to indicate that the quality of engineering personnel available to the members of the association has changed ? If it has deteriorated what can be done to improve the quality ?
7. Are there any difficulties regarding recruitment in certain regions, and if so, for what categories ? सत्यमेव जयते
8. What incentives do you consider necessary for encouraging mobility of engineering personnel ?
9. What are the comments of the association on the interim recommendations of the Committee ?
10. At what age do the engineering personnel retire from private employment ?
11. In the training of engineering personnel what is the wastage experienced by your members ?

LIST OF OCCUPATIONAL TITLES.

- | | |
|------------------------------|----------------|
| 1. Graduate Engineers | (Civil) |
| 2. -do- | (Mechanical) |
| 3. -do- | (Electrical) |
| 4. Diploma-holders | (Civil) |
| 5. -do- | (Mechanical) |
| 6. -do- | (Electrical) |
| 7. Mistries or sub-overseers | |
| 8. Masons | |
| 9. Carpenters | |
| 10. Plumbers | |
| 11. Glaziers | |
| 12. Painters | |
| 13. Tracers | |
| 14. Blacksmiths | |
| 15. Fitters | |
| 16. Electricians | |

The above list is only suggestive and may be amplified. Information on semi-skilled and unskilled categories is not wanted.



Average Norms as Supplied by States & Ministries.

Development Sector	Average of Norms supplied by States	Norms supplied by Ministries	Norms in the Private sector																																																
Buildings & Roads	<p>In the Public Works Departments, Buildings and Roads Branch, a construction division handles about Rs. 30 lakhs worth of work in a year. There are usually four assistant engineers (sub-divisional officers) under one executive engineer, and about four overseers against each assistant engineer. These are the departmental requirements. Usually, buildings and roads are combined in a division. Most of the work is done through contractors. Except for class I contractors, the contractors usually do not employ engineers and even diploma-holders. Most of the divisions are combined construction and maintenance divisions. For a maintenance division the expenditure per year is about Rs. 15 lakhs. For maintenance work, it is reported that contractors usually do not employ engineers on such works. Taking into account the staff needed for design and planning, the number of man-years needed per crore rupees of expenditure are about the following, excluding provision for leave and other reserves.</p> <p>a) <u>Construction.</u></p> <table><tr><th>Branch of Engg:</th><th>Graduate Engrs:</th><th>Diploma holders</th></tr><tr><td>Civil</td><td>17</td><td>60</td></tr><tr><td>Electrical</td><td>2</td><td>8</td></tr></table> <p>b) <u>Maintenance.</u></p> <table><tr><th>Branch of Engg:</th><th>Graduate Engrs:</th><th>Diploma holders</th></tr><tr><td>Civil</td><td>31</td><td>110</td></tr><tr><td>Electrical</td><td>4</td><td>16</td></tr></table>	Branch of Engg:	Graduate Engrs:	Diploma holders	Civil	17	60	Electrical	2	8	Branch of Engg:	Graduate Engrs:	Diploma holders	Civil	31	110	Electrical	4	16	<p>A division in the Central Public Works Department deals with about Rs. 41.25 lakhs worth of work in a year. The yardsticks furnished by the Ministry of W. H. & S. are as below. These yardsticks include the requirements of contractors.</p> <p>a) <u>Construction.</u></p> <p>For a work-load of Rs. one crore per annum the following staff is needed.</p> <table><tr><th>Branch of Engg:</th><th>Graduate Engrs:</th><th>Diploma holders</th></tr><tr><td>Civil</td><td>16.2</td><td>64.8</td></tr><tr><td>Electrical</td><td>2</td><td>8</td></tr><tr><td>Public Health</td><td>1</td><td>4</td></tr><tr><td>Architect</td><td>0.7</td><td>2.8</td></tr><tr><td>Town planners</td><td>0.1</td><td>0.4</td></tr></table> <p>b) <u>Maintenance.</u></p> <p>The maintenance expenditure on the average has been taken as 1% of the capital cost per annum. For work load of Rs. one crore per annum, the norms have been stated by the Ministry as below.</p> <table><tr><th>Branch of Engg:</th><th>Graduate Engrs:</th><th>Diploma holders</th></tr><tr><td>Civil</td><td>34</td><td>170</td></tr><tr><td>Public Health</td><td>3</td><td>15</td></tr><tr><td>Electrical</td><td>8</td><td>40</td></tr></table>	Branch of Engg:	Graduate Engrs:	Diploma holders	Civil	16.2	64.8	Electrical	2	8	Public Health	1	4	Architect	0.7	2.8	Town planners	0.1	0.4	Branch of Engg:	Graduate Engrs:	Diploma holders	Civil	34	170	Public Health	3	15	Electrical	8	40	<p>Except for class I contractors, the contractors usually do not employ engineers. It is learnt from the Ministry of W. H. & S. that for the works of C. P. W. D. a class I contractor is expected to employ on construction work, for a work-load of rupees one crore per annum about 7 Graduate Engineers (Civil) and 7 Diploma holders (Civil). Another building contractors' firm in West Bengal has stated that they employ about 13 Graduate Engineers and 30 Overseers (Civil) per crore rupees per year of work-load.</p>
Branch of Engg:	Graduate Engrs:	Diploma holders																																																	
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For Roads, the Ministry of Transport has given an average norm of an expenditure of Rs. 40 lakhs per annum per construction division and Rs. 15 lakhs per annum per maintenance division.

Development Sector.	Average of Norms supplied by States.	Norms supplied by Ministries	Norms in the Private sector.
Irrigation & Power.	The yard-sticks furnished by the Ministry of Irrigation and Power are those arrived at by the River Valley Projects Technical Personnel Committee. These also represent the average of the practice in the various States. The same are reproduced below, in a summarised way and the same represent the departmental needs only. The needs of the contractors are negligible as far as the engineers are concerned except those of class I contractors.		
	Man-years per crore rupees of expenditure on construction required in case of River Valley Projects.		
Category of Personnel	Multipurpose Projects	Pure Irrigation Projects	Pure Hydropower Projects
	Costing more than Rs. 10 crores	Costing less than Rs. 10 crores	Costing more than Rs. 10 crores
Graduate Engineers* (Civil)	14	17	14
—do— (Mechanical)	2.20	1.56	1.33
—do— (Electrical)	4.45	0.36	5.53
Overseers and Draftsmen (Civil)	38	55	53
Overseers and Draftsmen (Mechanical & Electrical)	6.7	8.7	14.0

Public Health Engineering

In the field of Public Health Engineering the norms have been supplied only by a few States. The Ministry of Health executes practically all their works through the States. From the data so far received the average norms are as below:—

Type of work Expenditure in lakhs per Division.

- (a) Construction.
- (i) Urban water supply and sanitation schemes. 20
 - (ii) Rural water supply schemes. 14
- (b) Maintenance. 63

Information not available.

Railways

For projects other than new lines, doubling and conversions, it has been assumed that an executive engineer at best can handle projects not exceeding Rs. 1 crore in value per annum. An executive engineer is on the average assisted by two asstt. engineers.

Information not available.

For new lines, doubling and conversions one District with two sub-divisions has been taken for every 40 miles. For maintenance, the following procedure has been adopted. The existing staff for maintenance of existing 34,000 miles of line is known. The staff required for maintenance for the new lines that will get completed may be taken pro-rata.

The requirements of Mechanical and Electrical staff greatly depend on the extent of mechanisation. The requirements of these departments have been worked by the Railway Board by assuming certain future trends and taking into account the peculiarities of various items of works.

Industries

No norms have been supplied to us yet. The figures of requirements supplied by the Ministries of Commerce & Industry and Production have been used.

Information not available.